RAILROAD GAZETTE

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Contributions

The Player Ash Pan.

Pittsburgh, Pa., June 7, 1902.

TO THE EDITOR OF THE RAILROAD GAZETTE:

I beg to call your attention to an error in the description of Player Improved Locomotive Ash Pan on page 411 of this week's issue of the *Railroad Gazette*. The statement is there made that the device was patented by *Mr. John Player, of the Atchison, Topeka & Santa Fe.* This is not correct, the fact being that it was patented by *Mr. John Player, Mechanical Engineer, of the American Locomotive Co., Brooks Works.*

There is also a slip of the types in the description of the Consolidation engine of the St. Louis & San Francisco on page 413 of the same issue, in the statement that "The wheels are all flanged except the drivers." The error is obvious on inspection. J. S. B.

[We take no responsibility for the error about Mr. Player, as we tried carefully to inform ourselves as to which Player was in question, and the information which we gave came directly to us from headquarters.

Concerning the flanges: If one will refer to the drawing, he will see that the main drivers are blind, and the coupled drivers are flanged. The ambiguity of our description came from the fact that it was prepared by a gentleman who is accustomed to British usage, according to which the main wheels are often called "drivers," and the others are spoken of as "coupled wheels." It is easy to see how such usage should have come down from the days of the "singles."—EDITOR.]

Wheel Failures and Wear of Rails on Curves.

Philadelphia, June 6.

TO THE EDITOR OF THE RAILROAD GAZETTE:

Since the introduction of the 80,000 and 100,000 lb. capacity cars there have been many failures of chilled iron wheels in service. The two classes of failures to be considered are:

First.—Transverse cracks in the tread produced by the heat generated by excessive brake action.

Second.—Longitudinal or circumferential cracks in the throat produced by heat generated by the excessive friction of the flange against the rail in curves, due to the side bearings and center plates not working freely, throwing the excessive work of overcoming this friction on the flange of the wheel.

The cause of failure in both cases is the same, i.e., heat. The chill crystals are radial, like the spokes of a wheel, with very little cohesion between them. In the transverse cracks, when one chill crystal breaks out, others break off easily like grains of corn from the cob. The longitudinal or circumferential cracks extend only through the chill but are of sufficient depth to cause the flange to break off under the severe lateral thrust. That these cracks in both cases are produced by heat is shown by the color of the fractured surfaces, which is, in all cases, the well-known purple due to heat.

To obviate this trouble one of our largest roads is now working on designs for roller side bearings and cast-steel center plates, machined, so as to get a free-swinging truck.

The important bearing of all this seems to be that the rails on curves have to withstand this excessive grinding action of the wheel flanges and this, no doubt, causes excessive wear of rails in curves. This point of excessive wear in curves has never been brought out as being due, indirectly, to the excessive friction necessary to turn the trucks in taking curves under the present system of side plates and center bearings.

F. L. MOISTER.

On "The Cause of Foaming in Locomotive Boilers."

New York, May 30, 1902.

TO THE EDITOR OF THE RAILROAD GAZETTE:

In the issue of the *Railroad Gazette* of October 12, 1900, I presented a paper bearing the above title, and beginning with the statement, "I have reasons for the belief that, under ordinary conditions of service, boiler foaming takes place only in the presence of particles of matter suspended in the water in the boiler. This belief is at variance with the usual opinions on the subject, and I therefore present some of my observations and the conclusions I have drawn therefrom."

I then proceeded to discuss the usual statement that boiler foaming is produced by the presence of alkali salts in the boiler water, and to state the reasons for my belief that boilers foam on the introduction of alkaline water only because the alkali throws into suspension the calcium and magnesium compounds originally dissolved in the water and also much of the scale attached to the tubes and sheets of the boiler.

Following this, I stated that in the laboratory boiling distilled water does not foam on the addition of the strong alkali pure sodium carbonate, even to the amount of several hundred grains per gallon, but does foam vigorously on the introduction of some fine insoluble powder such as calcium carbonate or magnesia alba.

In continuation, the paper discussed the theoretical considerations involved and proceeded to show how the various cases of boiler foaming are easily explained in accordance with the theory that, "under ordinary conditions of service, foaming takes place only in the presence of particles of matter suspended in the water in the boiler," while some are apparently inexplicable on any other theory.

At that time I had had no opportunity to make tests on a locomotive in service and my statement was based upon theoretical considerations, laboratory tests and observations on stationary boilers.

During the months of May and June, 1901, however, through the determination of the Management of the Rio Grande Western Railway to learn the possibilities of purification in the matter of the extremely bad water of the Colorado Desert, I had abundant opportunity to test and demonstrate the correctness of my theory.

The distance across the Colorado Desert by the line of the Rio Grande Western from Helper to Grand Junction is approximately 175 miles. At each of the terminal points, Helper and Grand Junction (Ruby), there is one of my water softening-and-clarifying machines to put into good boiler condition the hard and muddy waters which supply the railroad at these places. At intervals across the Division there are some eight or nine points at which ordinary hard water may be taken.

Previous to my visit the locomotives had taken water at any of the different stations as required, and it had been noticed that the boilers generally foamed after taking soft clear water from my machines. Upon my arrival, however, arrangements were made to equip one test locomotive with two water cars of sufficient capacity to carry the locomotive with a freight train across the Division, with softened water only.

Before starting, the boiler was thoroughly washed at Helper, so that all mud and loose scale were taken out (though a nearly uniform coat of hard scale ⅛ in. thick remained), then the boiler and the two water cars were filled with the soft clear water from my machine, and the test began. The run to the other end of the Division was made, for the first time in the history of the locomotive, without the faintest sign of foaming, though the train was heavy and there are numerous grades, and the engine was not spared. At the end of the run, after blowing out the water from the bottom of the boiler to free it from the loosened scale, another supply of softened water was taken on from my machine at Ruby, and the return run was made with equally satisfactory results.

Following this the operation was repeated day after day, until it was demonstrated beyond question that the locomotive supplied exclusively with the soft clear water from my water-softening machines could be operated to the limit of her speed and power, without foaming, so long as the old scale which was slowly flaking off was not allowed to accumulate in the bottom of the boiler. It was found that at first a run of 350 miles brought down enough fine scale to make her foam, when, of course, she had to be washed out, but as the old scale in the boiler gradually grew less it came down more slowly, and soon we were able to run 1,400 miles between washings.

Then, one day, after the boiler had been thoroughly washed out, I dissolved in the tender and car waters almost pure sodium carbonate, to the amount of 300 grains per gallon of water, and started the run with an extra heavy train—indeed, about the limit of the hauling capacity of the locomotive; and there was for several hours no more sign of foaming, up hill or down, than if the alkali had been left out. Before the end of the run, however, large quantities of old scale were loosened and considerable foaming followed. That night we washed out of the boiler more than twice as much loosened scale as usual, and the next day repeated the test with similar results, viz., no foaming due to alkali, but later, plenty of foaming due to loosened scale whipped fine.

This was the only demonstration lacking to my paper of October 12, 1900, and I now consider the statement proved beyond question that, "under ordinary conditions of service, boiler foaming takes place only in the presence of particles of matter suspended in the water in the boiler."

C. HERSCHEL KOYL.

Detroit Steel Car Works of the American Car & Foundry Company.

[WITH AN INSET.]

The first all-steel car plant to be put in operation by the American Car & Foundry Co. is just now nearing completion at Detroit. It is on land formerly occupied by the lumber yard of what were the Peninsular Works of the old Michigan-Peninsular Car Co. and is operated in conjunction with these works. In Fig. 1, showing the general view of the plant, some of the buildings of the Peninsular Works are visible on the right, near the foreground. Although cars are being built, all of the equipment has not yet been installed, consequently the plant is not yet running to its full capacity. Just what this will be is not yet accurately known, but it is thought that about 40 steel underframes for box cars, 30 all-steel gondola and 25 all-steel hopper cars will be turned out per day of 10 hours.

Ground was broken in March, 1901, and the first cars were built in January, 1902. The plant comprises a main building in two sections, each 94 x 730 ft.; a power house, 80 x 160 ft., and a pattern shop and building for template making and storage, 80 x 160 ft. The building in the foreground in Fig. 1 is not a part of the plant. All of these buildings have steel frames with brick walls and the first two have slate roofs. The pattern and template building has a gravel roof.

The main building has a clear height of 40 ft. to the bottom chord of the roof truss. As already mentioned this building is in two parallel sections, each 94 ft. wide and separated by the line of columns supporting the roof trusses. One side, the left as seen in Fig. 1, is known as the press department and the other side is the erecting department. Views of these two departments are shown in Figs. 2 and 3. All building and machine foundations are concrete. The soil conditions being favorable, the foundation depths run from 5 to 7 ft. The shop is extremely well lighted, there being a double row of windows in the side walls, numerous skylights in the roof, and windows in the monitors. All windows are glazed with ribbed skylight glass which diffuses the light with agreeable effect.

The constructional features of the power house are similar to those of the main building. The power installation was made by Westinghouse, Church, Kerr & Co. A battery of four Babcock & Wilcox 300 h.-p. boilers supply steam at 160 lbs. They are equipped with Roney stokers and a Green economizer. There is space in the boiler room for an additional unit of the same capacity and an economizer sufficiently large to take care of this fifth unit was put in. The average temperature of the feed water delivered by the economizer is 280 deg. An induced draft system is employed with the boilers, having a duplicate set of New York fans, only one of which is used at a time. An 8-ft. steel stack, extending a short distance above the roof, conducts the furnace gases away, and it is worthy of note that no smoke is visible at the top of this stack. Provision is made for cutting out the economizer in case of necessity for repairs. There are two Worthington pumps in duplicate for boiler feed.

The power units in the engine room, Fig. 4, are composed of Westinghouse vertical compound engines, direct-connected to Westinghouse 250 k.-w. multipolar, direct-current generators giving 240 volts at 250 r. p. m. There are three of these units already installed and space is provided and the foundations are in place for two additional. Two of the units now running are sufficient to supply the present demand for light and power. A 9-panel marble switchboard controls the electrical equipment. Two panels govern the power circuits, three the lighting circuits and three the machines. In addition to the usual switchboard equipment, including circuit breakers, there is a Thomson recording wattmeter. Equalizing switches are placed on floor stands between the machines. For lighting, 110-volt incandescent lamps and Manhattan 220-volt enclosed arc lights are used. The incandescent lamps are connected two in series across the 220-volt mains.

Two Westinghouse hydraulic 350-gallon pumps will supply water at 1,500 lbs. pressure for the presses and riveters in the shop. One of these is seen on the right, in Fig. 5. The other has not yet been placed on the foundation, a part of which is visible at the right-hand

side of the picture. They are duplex pumps, having triple-expansion steam ends. Two Worthington steam accumulators act as pump governors, the steam supply to the pumps being regulated by the consumption of water at the tools. In addition each pump is provided with a speed governor. Air is supplied to the hoists and pneumatic tools by an Ingersoll-Sergeant cross-compound Corliss two-stage compressor, having a capacity of 4,000 cu. ft. of free air per minute at 82 r. p. m., the delivery pressure being 100 lbs. This is a new type of compressor recently brought out by the Ingersoll-Sergeant Co., having air-thrown, mechanically-operated air-inlet and discharge valves.

A Worthington central elevated jet condenser takes care of the exhaust steam not used in the heater, the capacity of this condenser being 28,000 lbs. per hour. The water of condensation is handled by a Worthington duplex circulating pump having tandem-compound steam cylinders and a double water end. One pair of water cylinders pumps the hot water from the hot well to the cooling tower and the other pair keeps the cold water in circulation between the cooling tower and condenser. There is also a Worthington rotative dry-vacuum auxiliary pump for use in hot weather when the temperature of the cooling water cannot be reduced sufficiently to give the desired vacuum in the jet condenser. The cooling tower referred to is a Worthington and is located just outside of the power house. The hot water is pumped to the top and is allowed to circulate downward through a special form of tiling so arranged that the water will be separated into thin sheets. A fan in the bottom of the tower circulates air through this bank of tiling, cooling the water. The fan is operated by a Westinghouse standard engine inside of the power house and belted to the fan shaft extending through the wall.

The floor of the engine room is elevated above the condenser floor, giving room for a basement underneath, having about 9 ft. of head-room. All exhaust pipes from the engines are led under the floor to a central heating apparatus (Fig. 4), the hot water from which heats the other buildings. There are controlling valves at the engines by which the exhausts may be directed either to the heating apparatus or to the condenser. The heater is of the enclosed tubular form and the water is circulated through the piping by one of a duplicate set of centrifugal pumps direct-connected to Westinghouse engines. The filter plant for filtering all of the water used in the hydraulic system is located in the basement. It consists of a mechanical filter and a storage tank.

All electrical conductors pass through the floor, along the ceiling of the basement and into a tunnel (Fig. 6), connecting the power station to the shop. This tunnel is 6 ft. wide and 8 ft. high from the floor to the center of the semi-circular arched roof. It is built of brick and has a concrete floor. The basement and tunnel drain into a sump-well having an overflow connected to the city sewer. All hydraulic pressure and return pipes, pneumatic and hot water heating pipes pass into the basement from their respective machines and through the tunnel to the main building. The electric conductors rise through the roof of the tunnel at each side wall and at the center columns and pass overhead for distribution. They are carried down the columns, and pass underground through loricated conduits to the machines. The various pipes come up at the same points at the sides as the electric conductors and pass into brick trenches having sectional wooden covers, making all joints readily accessible.

The main building is heated by hot air circulated by two motor-driven New York fans, which draw in the air over a stack of cast-iron radiators through which the hot water from the heater in the power station basement is pumped. The temperature of this shop is maintained at 60 deg. in zero weather. The template and pattern shop is heated by direct radiation from hot-water coils.

The division of the shop into two general departments of press and erecting has already been mentioned. The material yard with its crane, plainly seen in Fig. 1, is at the end of the building from which the views were taken and consequently the shearing and punching machinery is located at that end, although the angle at which the photographs of the interior were made shuts out most of these machines. All of the tools are motor driven, the large ones independently and the small ones from line shafting belted to a motor. Both departments are served by cranes, there being three in the erecting side and two in the press side. They are Niles electric cranes of 10 tons capacity with a span of 91 ft. and a travel including the length of the building. It will be noticed that they have latticed girders, giving them a very light appearance. The crane in the steel yard is an exact duplicate of those in the shop. The runway is carried on latticed steel columns resting on concrete foundations, except where it passes the front of the shop, this portion being carried by the wall of the building. The runway is 440 ft. long and for all the cranes the runways are 32 ft. above the ground.

Referring to Fig. 2, showing the press department, the most prominent tools to be seen are the bulldozer, near the wall at the left, and the hydraulic press in the foreground. In Fig 7 a closer view of this press is shown, the novel feature of which is the placing of the ram overhead. By this arrangement the material to be pressed remains stationary. This press, built by the Morgan Engineering Co., Alliance, Ohio, has a capacity of 1,000 tons, and the movable parts weigh 72 tons. A pressure of 3,000 lbs. per sq. in. is obtained by means of the intensifier at the right, which doubles the pressure supplied by the pumps. The press is provided with three dies, one of which is seen in the foreground, and a steel side sill may be formed in three operations of the press by moving from one die to another.

Furnaces for hot pressed and bulldozer work may be seen ranged along the wall in Fig. 2. There are four of these in the shop, all of which were installed by the American Stoker Co. They are equipped with automatic stokers and burn slack coal. Blasts for these furnaces are furnished by three fans located in different parts of the shop. They are motor-driven, being direct-connected, and the blast-pipes are all underground.

One of the most interesting tools in the shop is that shown in Fig. 8 and is a Long & Allstatter multiple punch with automatic spacing table. This machine is 10 ft. between housings and has capacity to punch 36 13-16 in. holes through ⅝-in. steel at one stroke. The spacing mechanism is on the left, the feed being regulated and controlled by the two levers seen. One lever adjusts the spacing in multiples of sixteenths and the other in multiples of ½-in., up to 8-in., providing for any scheme or variation of spacing in the same work. A Stephenson link-motion is employed to give the adjustment mentioned. The spacing can be changed while the machine is in operation and any or all of the punches can be thrown out by means of "gags." The automatic feed-table will carry plates 46 ft. long. There are two of these large punches and two smaller, having capacity for six holes of the dimensions given above.

The equipment in the erecting department being still incomplete, resort is had to temporary devices in some cases, one of which is the small crane-runway seen on the right of the farther end in Fig 3, over the erecting track. This runway is built of timber at present, though it is the intention to substitute steel for it. It serves track room sufficient for seven 45-ft. cars and over each car there is a small crane carrying a small hydraulic riveter. Riveters for the larger, heavier work are ranged along each side of the erecting department for about half its length, there being 10 altogether. They are spaced 50 to 60 ft. apart and have a throat depth sufficient to take the side of the largest-capacity hopper bottom car. They are set into the ground to a depth that brings the dies at a convenient height for an operator standing on the ground and a brick trench 3 ft. wide, 6 ft. 6 in. deep and running the length of the group enables the parts to be lowered into place for riveting. An overhead I-beam runway, supported on brackets and having trolleys, furnishes a convenient means of handling the parts.

The truck department is at the farther end of Fig. 2, or the press side. It is served by a 3-ton crane having a 45-ft. span. The erecting tracks for the trucks have shallow pits on either side to bring the workman down to a level convenient for his work.

Pneumatic hoists and tools are used quite extensively and the shears and punches are served by swinging jib cranes having air hoists.

The American Car & Foundry Co. has another plant building at Berwick, Pa., which is substantially a duplicate of the Detroit plant.

Acknowledgments are due Mr. George B. Hargreaves, District Manager, for the opportunity allowed us to obtain this description and to his assistant, Mr. J. H. Ames, for information furnished.

Staybolt Breakage.

On a southwestern railroad having a total mileage of about 2,322 miles, and operating 249 locomotives, the question of broken staybolts has always been an exceedingly serious one, and as a measure of safety it has been found necessary to have all locomotives carrying 180 lbs. steam pressure inspected every 30 days for broken staybolts, and small locomotives carrying 140 and 150 lbs. inspected every 60 days. Diagrams have been prepared showing the location of the staybolts in the side sheets, back flue sheet, and door sheet of each class of locomotive, and when the inspector tests a boiler he marks on the diagrams the location of each staybolt found broken. After the broken staybolts have been renewed, the diagrams are returned to the office of the Superintendent of Machinery, so that an accurate record can be kept not only of the total number of staybolt breakages that occur, but also of the location in the fire-box of these broken bolts. One of the best qualities of staybolt iron (Taylor) is used, not only in the construction of the locomotives when new, but also in renewing broken bolts, and every possible precaution is taken to renew the broken bolts as soon as discovered in order that unnecessary strains may not be thrown on the adjoining bolts. The water in a good many districts is known by analysis to be bad, and during the year 1901 a record of the breakage of the staybolts in the different districts was kept in order to determine as far as possible what the influence of the water was on this breakage.

The expense entailed by the broken staybolts cannot well be determined, as the cost of renewing these bolts is not only for the material used and the time of the

TABLE A.

Engine No.	Staybolts broken.	Engine No.	Staybolts broken.	Engine No.	Staybolts broken.	Engine No.	Staybolts broken.	Engine No.	Staybolts broken.	Engine No.	Staybolts broken.	Engine No.	Staybolts broken.	Engine No.	Staybolts broken.
1	0	37	0	73	11	109	20	145	28	181	90	217	1		
2	22	38	34	74	4	110	1	146	75	182	376	218	64		
3	18	39	0	75	0	111	25	147	155	183	30	219	1		
4	4	40	4	76	0	112	9	148	77	184	70	220	1		
5	55	41	0	77	0	113	20	149	32	185	0	221	112		
6	14	42	4	78	27	114	18	150	68	186	189	222	4		
7	6	43	51	79	0	115	0	151	3	187	47	223	3		
8	0	44	0	80	12	116	16	152	29	188	37	224	119		
9	4	45	2	81	0	117	17	153	84	189	85	225	12		
10	29	46	8	82	0	118	55	154	127	190	221	226	21		
14	16	47	0	83	0	119	0	155	76	191	44	227	0		
12	60	48	2	84	57	120	0	156	23	192	36	228	38		
13	23	49	1	85	23	121	29	157	0	193	289	229	153		
14	12	50	1	86	22	122	9	158	44	194	20	230	5		
15	0	51	2	87	45	123	12	159	0	195	39	231	105		
16	4	52	0	88	20	124	35	160	0	196	36	232	99		
17	0	53	5	89	0	125	0	161	68	197	64	233	93		
18	7	54	1	90	30	126	39	162	0	198	71	234	1		
19	3	55	19	91	5	127	41	163	42	199	107	235	32		
20	0	56	13	92	2	128	4	164	0	200	73	236	25		
21	42	57	3	93	8	129	28	165	111	201	62	237	1		
22	0	58	45	94	18	130	30	166	116	202	141	238	0		
23	13	59	0	95	0	131	3	167	55	203	136	239	125		
24	15	60	14	96	57	132	2	168	186	204	73	240	23		
25	38	61	14	97	17	133	8	169	65	205	3	241	234		
26	13	62	59	98	50	134	45	170	93	206	134	242	6		
27	7	63	0	99	11	135	33	171	58	207	77	243	4		
28	54	64	0	100	7	136	..	172	175	208	65	244	296		
29	5	65	15	101	15	137	23	173	238	209	57	245	4		
30	7	66	6	102	13	138	..	174	100	210	74	246	2		
31	0	67	0	103	11	139	63	175	106	211	1	247	197		
32	3	68	3	104	11	140	10	176	96	212	99	248	38		
33	0	69	1	105	1	141	15	177	44	213	4	249	57		
34	2	70	3	106	29	142	70	178	76	214	0	250	8		
35	2	71	12	107	12	143	43	179	157	215	0	251	15		
36	1	72	3	108	28	144	16	180	1	216	0				
												Total.	9,446		

TABLE B.

Class.	Type.	No. of Engines in class.	Steam pressure, lbs.	Miles run during 1901.	No. of Staybolts per engine.	Total No. of Staybolts broken.	Avge No. of Staybolts broken per engine.	Per cent. of Staybolts broken to total in service.	No. of Staybolts broken per 10,000 miles run.
A	4-wheel switch	7	140	153,399	426	8	1.14	.27	.52
B	6-wheel switch	2	"	51,431	354	0	0	0	0
B-1	"	3	"	63,377	716	43	14.33	2.01	6.78
C-1	8-wheel	2	"	64,477	461	2	1.	.22	.31
C-2	"	2	"	27,746	521	10	5.	.96	3.60
C-3	"	13	"	490,040	573	46	3.54	.62	.94
C-4	"	3	"	84,296	593	27	9.	1.52	3.21
C-5	"	6	"	258,032	573	14	2.33	.41	.54
C-6	"	9	"	191,441	639	57	6.33	.99	2.98
C-7	"	5	"	180,074	623	26	5.20	.83	1.45
C-8	"	2	"	61,821	661	21	10.50	1.59	3.40
C-9	"	1	"	54,817	661	0	0	0	0
C-10	"	2	"	125,647	661	38	19.	2.87	3.03
D	Mogul	1	"	32,425	354	0	0	0	0
D-1	"	1	180	15,907	1.089	51	51.	4.68	32.06
E	Bogie	10	150	151,307	863	318	31.80	3.68	21.02
F	10-wheel	50	140	1,635,559	629	1,027	20.54	3.27	6.28
F-1	"	7	180	163,592	896	275	39.29	4.38	16.82
F-2	"	5	"	177,985	1.030	335	67.	6.50	18.81
F-3	"	35	"	1,186,901	1.030	2,925	83.57	8.11	24.62
F-4	"	10	"	657,477	1.176	854	85.40	7.26	12.99
G	Consolidation	3	150	57,032	771	21	7.	.91	3.69
G-1	"	3	"	75,132	928	46	15.33	1.65	6.12
G-2	"	10	180	294,632	1.383	864	86.40	6.25	29.32
G-3	"	56	"	1,959,833	1 200	2,404	42.93	3.58	12.26
G-4	"	1	"	11,340	1.426	34	34.00	2.38	29.90
Totals.		249	...	8,225,748	.....	9,446	37.94	....	.....

boiler makers in making these renewals, but also the loss to the company brought about by the necessity of taking an engine out of service in order to do the work, which sometimes occurs when the engine is badly needed to move trains.

There are four principal divisions on this road and for the sake of convenience they will be specified as 1, 2, 3 and 4. During the year 1901 the breakage of staybolts was distributed amongst the divisions as follows:

Div. No.	1	1,187 bolts broken
" "	2	2,847 " "
" "	3	240 " "
" "	4	5,172 " "

From these figures it will be seen that on Division No. 2 over twice as many staybolts were broken as on Div. No. 1, and that on Div. No. 4 almost 1,000 more bolts failed than on all the rest of the system put together.

The number of miles of track in each division is as follows:

Div. No.	1	531 miles
" "	2	908 "
" "	3	440 "
" "	4	443 "

The average number of locomotives on each division was:

		140 lbs. Steam Pressure.	180 lbs. Steam Pressure.	Total.
Div. No.	1	26	50	76
" "	2	49	21	70
" "	3	20	0	20
" "	4	24	59	83

From these figures it may be seen that on Divs. 1, 2 and 4 there was not such a great difference in the number of locomotives to account for the large difference in number of staybolts broken. Div. No. 3 is of such minor importance that it cannot be considered as entering this comparison. The quality of the water on the four divisions varies a great deal, that on Div. No. 4 being the worst, on No. 2 the next, and on No. 1 the best.

Table "A" shows the number of staybolts broken by each of 10 locomotives, these being arranged according to numbers and without regard to class.

Referring to this table, the great differences in numbers of staybolts broken per engine will be seen, the 10 engines breaking the greatest number of staybolts being as follows:

Engine No.	182	376 bolts broken
" "	244	296 " "
" "	193	289 " "
" "	173	238 bolts broken
" "	241	234 " "
" "	190	221 " "
" "	247	197 " "
" "	186	189 " "
" "	168	186 " "
" "	172	175 " "
Ten engines		2,401 bolts broken

In these 10 engines there was an average of 240.1 staybolts broken per engine, or in about 4 per cent. of the total number of engines on the system, over 25 per cent. of the total number of broken staybolts occurred.

Engines 168, 172, 173, 182 and 186 are all 10-wheelers, Class F-3, with Belpaire boilers and carrying 180 lbs. steam pressure. Fig. 1 shows the design of the fire-box of this boiler. They made all their mileage on Div. No. 2. The average length of service of these engines was 4 years 7 months.

Engines 190 and 193 are also 10-wheelers, Class F-4, with Belpaire boilers, and carrying 180 lbs. steam pressure, but the design of the fire-box is quite different from that of the preceding engines as will be seen from Fig. 2. They also made their mileage on Div. No. 2, and the length of service was 4 years and 3 months.

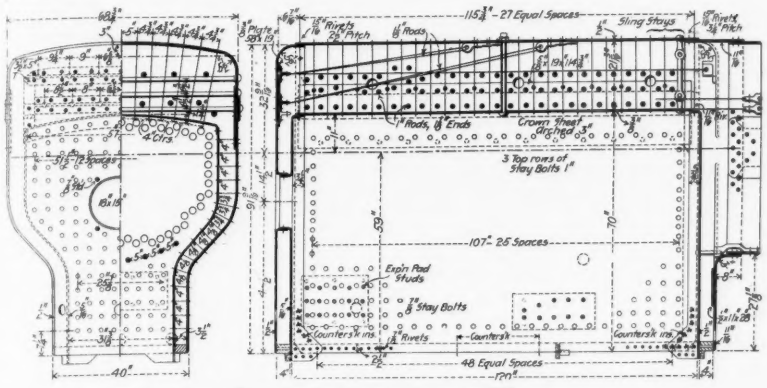


Fig. 1.—Ten-Wheel Class F-3.

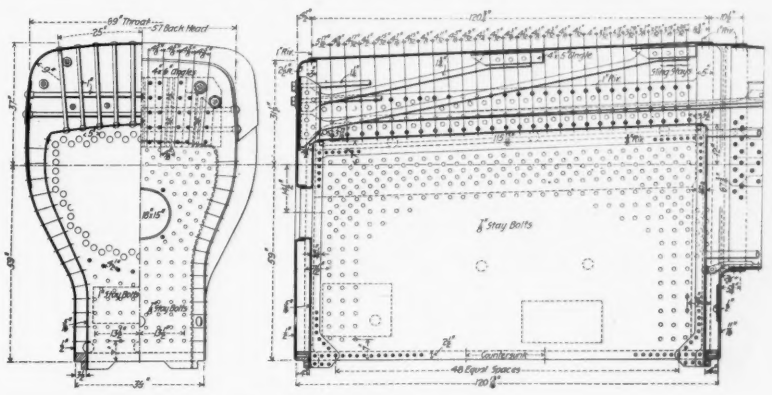


Fig. 2.—Ten-Wheel Class F-4.

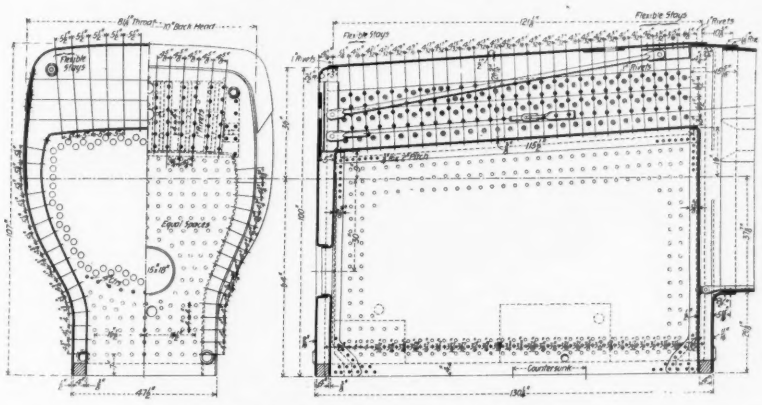


Fig. 3.—Consolidation Class G-2 and G-3.

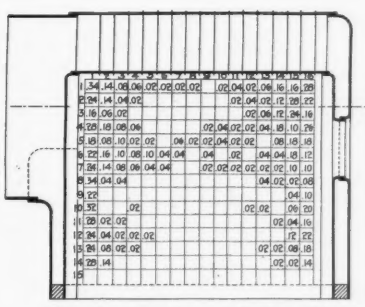


Fig. 4.—Location of Broken Staybolts in R. & L. Side Sheets. Class F Engines. Average of 50 Engines.

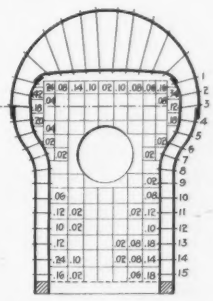


Fig. 5.—Location of Broken Staybolts in Door Sheet. Class F Engines. Average of 50 Engines.

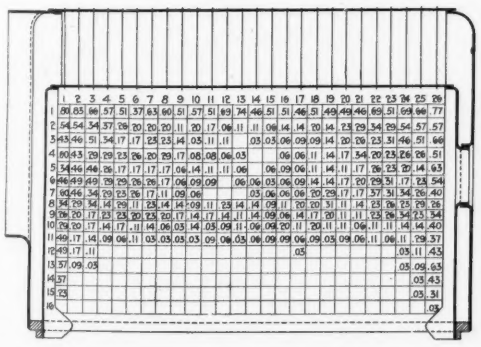


Fig. 6.—Location of Broken Staybolts in R. & L. Side Sheets. Class F-3 Engines. Average of 35 Engines.

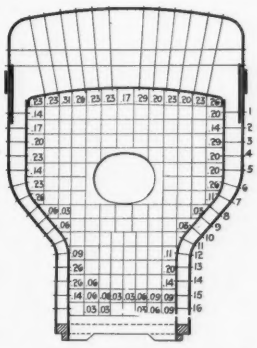


Fig. 7.—Location of Broken Staybolts in Door Sheet. Class F-3 Engines. Average of 35 Engines.

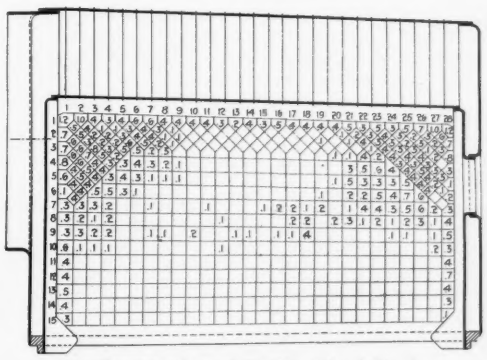


Fig. 8.—Location of Broken Staybolts in R. & L. Side Sheets. Class F-4 Engines. Average of 10 Engines.

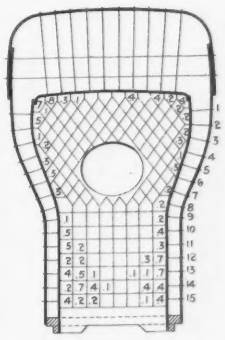


Fig. 9.—Location of Broken Staybolts in Door Sheet. Class F-4 Engines. Average of 10 Engines.

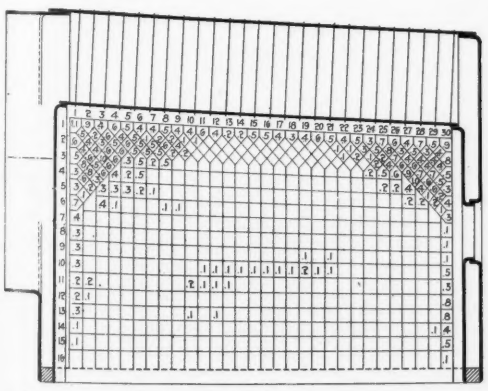


Fig. 10.—Location of Broken Staybolts in R. & L. Side Sheets. Class G-2 Engines. Average of 10 Engines.

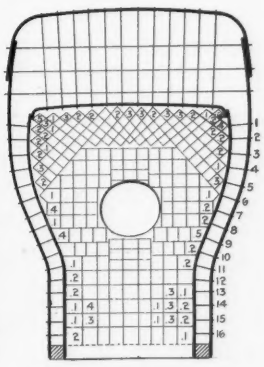


Fig. 11.—Location of Broken Staybolts in Door Sheet. Class G-2 Engines. Average of 10 Engines.

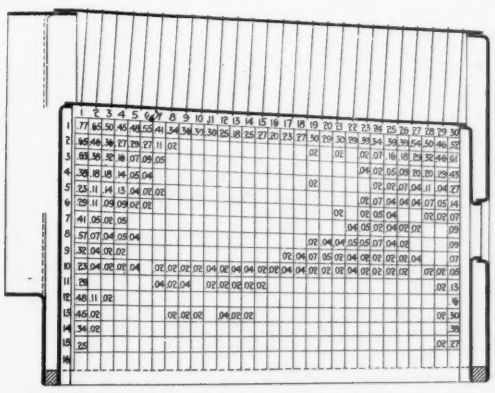


Fig. 12.—Location of Broken Staybolts in R. & L. Side Sheets. Class G-3 Engines. Average of 56 Engines.

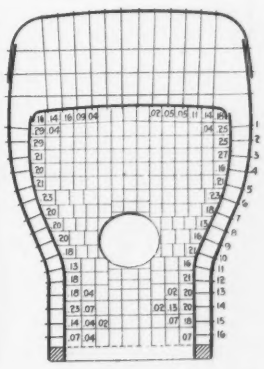


Fig. 13.—Location of Broken Staybolts in Door Sheet. Class G-3 Engines. Average of 56 Engines.

A STUDY IN BROKEN STAYBOLTS.

Engines 241, 244 and 247 are consolidation locomotives, Class G-3, with Belpaire boilers, carrying 180 lbs. steam pressure, and the design of their fire-box shown by Fig. 3 is similar to that of 190 and 193. They made their mileage on Div. No. 4, and their average time of service was only 1 year 11 months.

Table "B" shows the breakage of staybolts arranged according to the classes of engines.

When a comparison was made of the number of staybolts broken in each district it showed that out of the five districts in which the greatest breakages occurred, three were on Div. No. 4 and two were on Div. No. 2, the breakage in the first three being 1,748, 1,385 and 1,379 staybolts, respectively, and on the latter two, 1,099 and 881, respectively. These results agree exactly with the analysis of the waters on the system, and show how great is the influence of the water on the staybolt breakage. As an example of this may be taken the case of engine 205, Class G-2, which for the last two years has been in service on Div. No. 1, in the best water district. During 1901 there were broken in this engine only three staybolts, while in the other nine engines of the same class running on Div. No. 4 in the worst water district were broken all the way from 62 to 141 staybolts.

In order to show the location of the broken staybolts in the fire-boxes, Figs. 4, 5, 6, 7, 8, 9, 10, 11, 12 and 13 have been prepared. Figs. 4 and 5 are of the side sheets and door sheet of Class F; 6 and 7 of Class F-3; 8 and 9 of Class F-4; 10 and 11 of Class G-2, and 12 and 13 of Class G-3. These are representative types of all the engines in service on the system. Each square or area represents an individual staybolt, and the number in the area equals the number of times which the staybolt represented by the area was found broken, divided by the number of engines in the class. The figures showing the side sheets give the breakages in both right and left sheets together, so that the numbers in the areas must be divided by two, to get the breakage in one sheet.

From Figs. 4, 6, 8, 10 and 12 can be seen that the greatest breakages in the side sheets occurred in the two vertical rows in each end of the fire-box, and in the top horizontal row. In Fig. 6 may also be seen that there is a very considerable breakage on the 7th, 8th, 9th, 10th and 11th horizontal rows, which Fig. 7 shows are those staybolts that are located where the fire-box decreases in width or in the ogee.

In Figs. 4, 8, 10 and 12 signs of this breakage also appear, but in no such marked manner as in Fig. 6, and by reference to Figs. 5, 9, 11 and 13, it appears none of these engines have such an extremely pronounced ogee as Class F-3, Fig. 7.

The breakage in the two vertical rows, front and back, is natural to expect and will most likely occur in any design of fire-box. The breakage in the top horizontal row is also one to be expected, and in designs of fire-boxes where the crown and side sheets unite in a sharp corner this breakage will be found. It can probably be brought to a minimum, if not done away with, except in the front and back corners of the fire-box, by flanging the sides of the crown sheet to an easy radius, say 12 in. or 14 in., which can be done in fire-boxes of the radial stay type, but not so well in the Belpaire.

The breakage in the 7th, 8th, 9th, 10th and 11th horizontal rows, Fig. 6, is due to a bad design and shows plainly the effect of sharp reverse curves in the sides of the fire-box. The fire-box sheets are thinner than the outside sheets and are heated first. Being held at the bottom by the mud-ring and at the top more or less firmly by the crown stays, the expansion due to the heating will cause buckling action in this reverse curve so that the sharper the curve, the more severe will be the strains on the staybolts. In this particular class of engines a great many staybolts in these five rows become loose in the sheets and have to be renewed even before they are actually broken. This breakage does not occur in the other types of engines except in a very slight manner, merely an indication, as the sides of the fire-boxes have much easier bends, Figs. 9, 11 and 13 being examples of good design of Belpaire fire-boxes in this respect.

The breakage in the back tube sheets and the door sheets on all the engines is practically confined to the extreme outside row, both at the top and sides, and will most likely continue in any design.

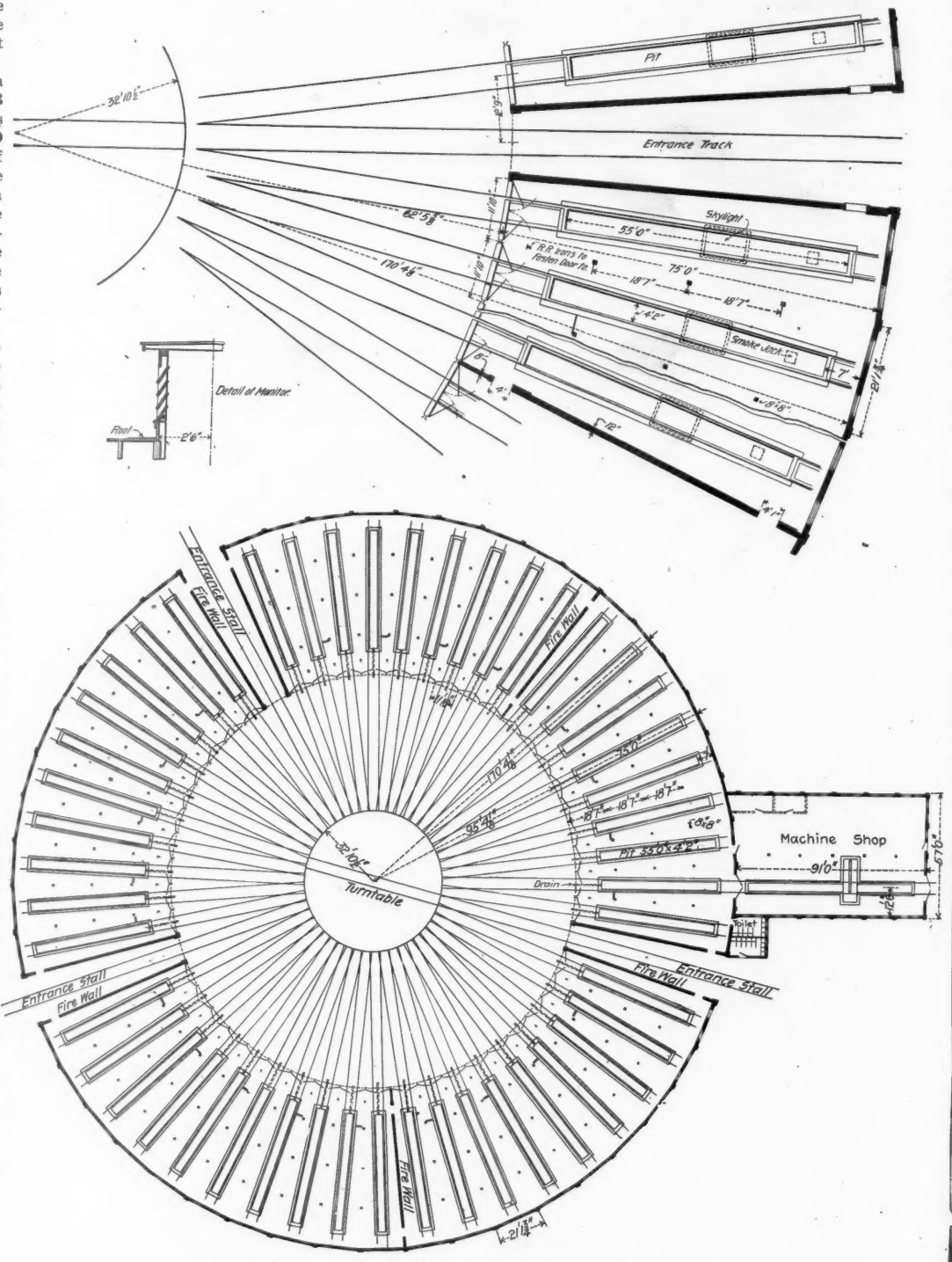
From the figures which have been given there can be no doubt of the injurious effect of bad water, particularly water which contains a large per cent. of incrusting matter, not only on the life of the staybolts, but also on the life of the fire-box, and where it is impossible to improve the quality of the water without extremely large expenditures, the best remedy appears to be in the design of the fire-box for future engines. By doing away with the reverse curves in the side sheets, by increasing the water space so as to use as long staybolts as possible, by having these bolts made of good soft iron, or perhaps in some places in the fire-box, flexible stays, seems at least a practical remedy to reduce the breakage to a minimum, and a radial stay boiler of the wide fire-box type having a width at mudring of from 66 in. to 80 in. would seem to embody these features.

New Engine House of the Boston & Maine at East Cambridge.

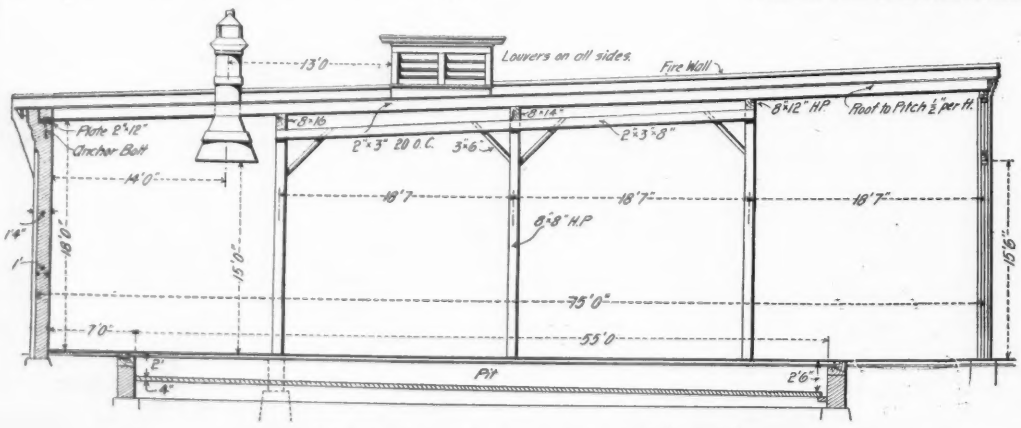
The new engine house and machine shop just completed at East Cambridge, Mass., by the Boston & Maine, has been rendered necessary by improvements made in the permanent way. The doing away with the Austin street grade and overhead bridge in East Cambridge interfered with the old engine house and shop, and it was determined to build more modern quarters.

The Boston & Maine handle, at this point, about 200 engines in 24 hours. Of these about 150 are passenger engines and the remaining 50 are freight. While no greater number of engines will be handled at the new engine house than were handled at the old, the new one will have enlarged capacity and greater facilities for doing the work.

The engine house is circular, having 47 service pits and three entrance tracks. One of the service pits, however, forms the entrance to the machine shop, which abuts on the circular engine house. The latter is a building 57 x 91-ft., having one service pit and drop pit for wheel removal. The turn-table situated in the center of the tracks radiating from the roundhouse is not covered. It is slightly over 65-ft. in length.



General Plan of Boston & Maine Engine House at East Cambridge.



Longitudinal Section of Boston & Maine Engine House.

In addition to the fire walls, one on each side of the entrance tracks, there are two in the body of the engine shed itself, making five divisions in the entire building. The entrance ways are not roofed over, and the fire walls are all carried up 18-in. above the roof. The whole building is of brick, including partitions, piers, track pits and floor. The floor bricks are laid flat. The house is so arranged that the engines head into it from the turn-table, so that the greatest shop width is where the engine stands, facing the windows, while the tenders are in the narrower portion. Two windows light the space occupied by each engine, while a skylight, with ventilation slats, stands on the roof, as nearly as possible over the spot where the dome of an engine will be, when the stack is under the smoke-jack. The smoke-jacks are made of wood, of ample proportions and hanging 15-ft. above the floor.

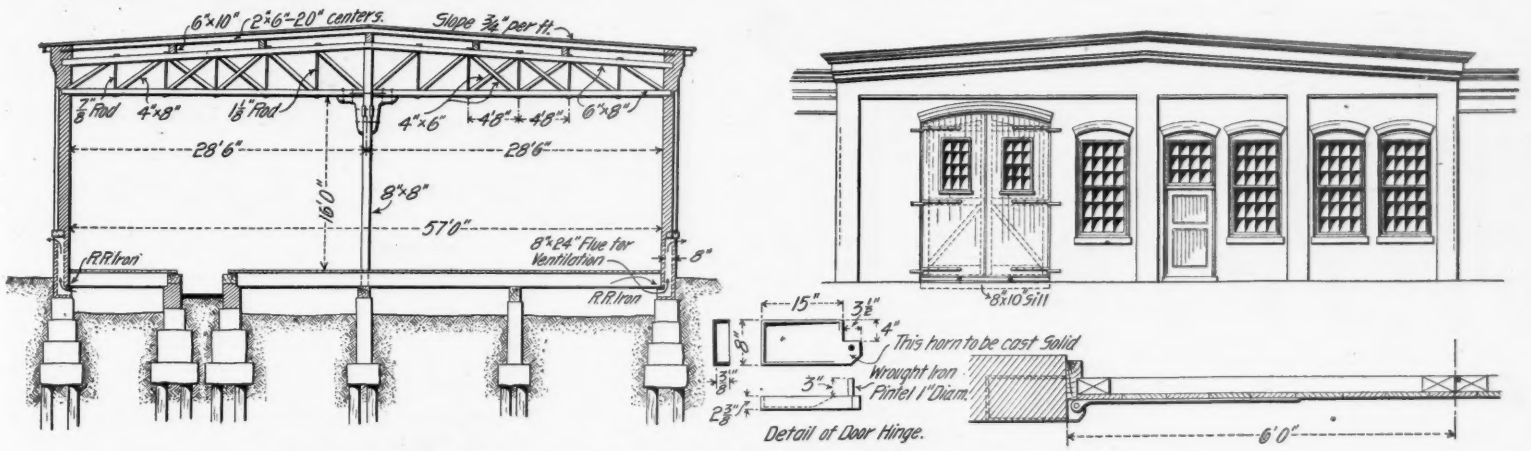
The pits are 55-ft. long by 42-in. wide, and are two feet deep at the smoke-jack end, with a fall of 6-in. toward the turn-table end. The pit is 7-ft. from the

front or outside wall of the roundhouse. The sides of the pits are built of 8-in. brick, the walls being lined on the inside with tarred paper, mopped between each layer with asphaltum and lapped at each corner. The pit walls are 16-in. thick, capped with an 8 x 16-in. timber upon which the rail rests, and beside the rail lies a 4½ x 10-in. stringer, which insures a very substantial foundation upon which to place blocking or jacks. The floor of the pit is made of brick, laid on edge and curved upward toward the center, which is 3-in. higher than the gutters which run close along the pit walls. The roof of the shed slopes away from the turn-table, but the drainage of the pits is toward the table. The front posts, those at the turn-table end of the engine house, are of soft steel, with wrought-iron hinge straps for the doors, which swing inward. This latter arrangement will probably be an advantage in winter, and the shop being 75-ft. long, the tenders of housed engines will be well out of the way of the doors.

The machine shop is separated from the running shed by a pair of doors which swing inward. A separate entrance track for the machine shop is secured by running one of the roundhouse pit tracks through. The machine shop therefore can receive an engine from the outside, or from the roundhouse as circumstances direct. The machine shop has a lining floor of square edge hemlock boards covered with a layer of water-proof paper, over which is laid a floor of 2-in. square edge hard pine boards planed on one side, and each about 8-in. wide. The space below the machine shop floor is ventilated. The shop contains a drop pit 20 x 7-ft., a tool-room and an air-brake room, partitioned off. A water closet adjoins the machine shop, but is entered only from outside or from the roundhouse. The machine shop is well lighted with windows on three sides, and contains also those of the engine house where its wall abuts.

The roof of the buildings is five-ply tar and gravel. Four courses of good tar paper are laid, with about 7-in. to the weather, the fifth layer being mopped on, and the whole covered with a good body of tar, upon which round gravel is laid.

The whole shop is modern and is of ample proportions, and every care has been taken to reduce the fire risk, as far as the building is concerned. The construction is substantial and should be easy to maintain. The turn-table is at such a distance from the shop that the rails from each pit cross before they reach the table. This arrangement requires the use of frogs, and, at present, as the circular area is laid out, the frogs lie at a distance of about 62½-ft. from the roundhouse doors. This distance gives room for an engine to stand entirely outside the shop without interfering with the turn-table. The doors are 11 ft. 10 in. wide, so that the engines of the largest size can be readily taken in and out of the engine house.



Cross Section and Side Elevation of Machine Shop at Boston & Maine Roundhouse—East Cambridge.

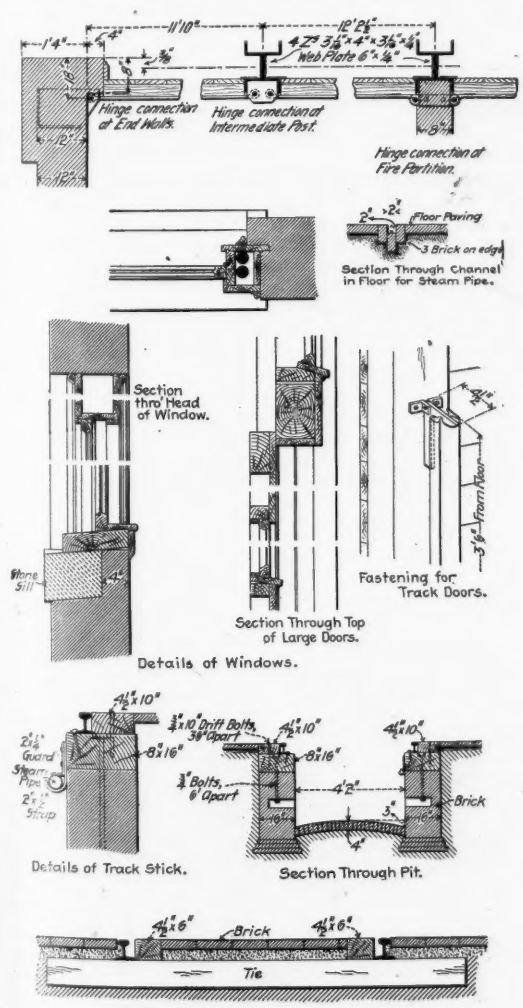
A Big Power Plant for Chicago.

What will upon completion be one of the largest power plants in the world will be begun shortly by the Commonwealth Electric Co. of Chicago on a tract of land just purchased by it for the purpose. The plot is some 14 acres in extent, 12 acres of which front south on the Chicago River between Morgan street and Center avenue, a short distance south of Twenty-second street; the remainder is directly across the river from the larger tract. The transfer price for the property was $337,000. Work will be begun at once on the power house, and it is intended to spend about $1,000,000 a year for six years, which is the time allowed for completion of the work. Thus it will be seen that the estimated cost is $6,000,000.

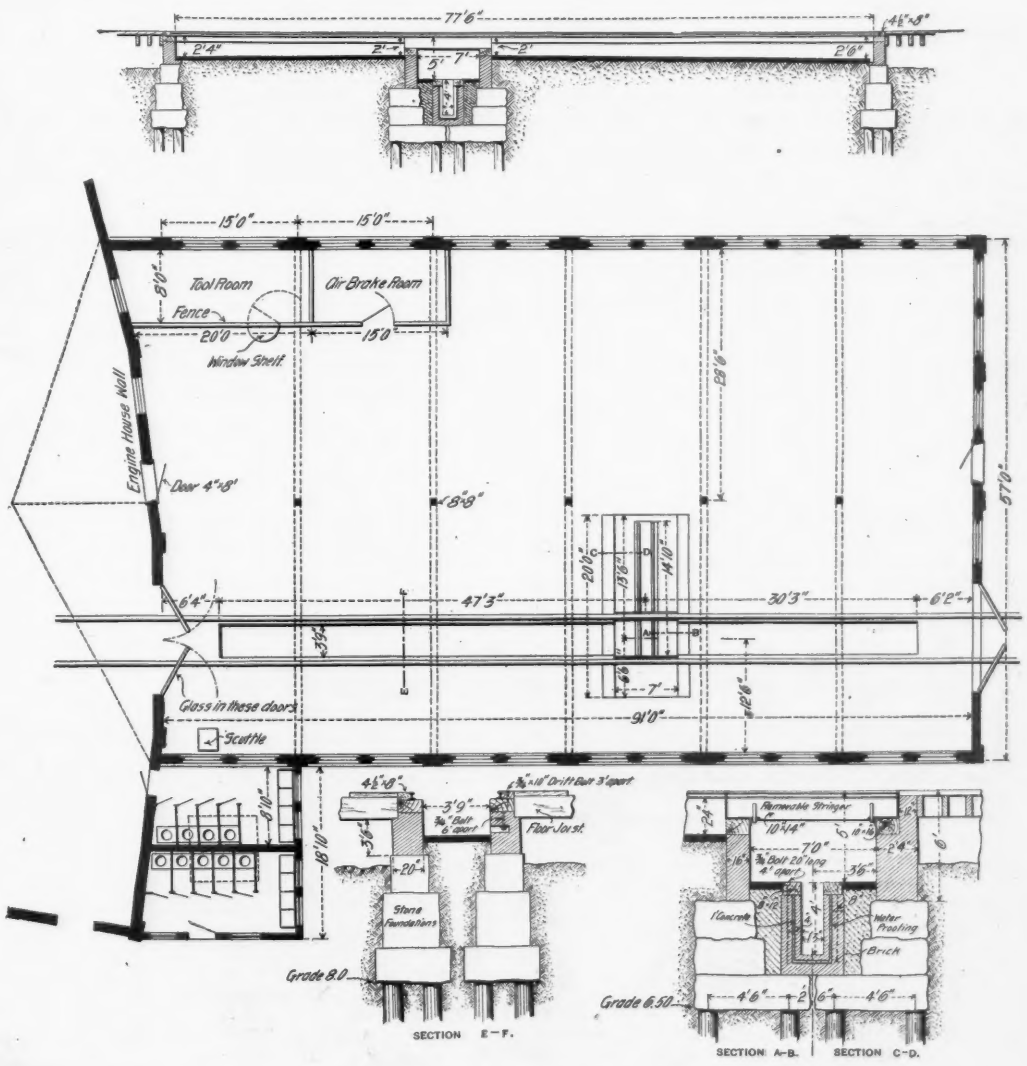
The proposed ultimate capacity of the plant is 100,000 h.p.; the first installation will be 16,000 h.p., and it is said this equipment has already been contracted for. Alternating current machinery is to be installed, and the intention is to supply current for railroad operation, and for lighting and power purposes. The Chicago Edison Co. will use a portion of the output since it is, even now, unable to supply the demand with its present facilities. It is said that the annual increased demand for light and power in Chicago is between 5,000 and 6,000 h.p., and that these figures would be even greater were the companies equipped to meet the demand. It will be seen by this that not many years will elapse before the Commonwealth Co. will have use for its entire output.

It is said that some features entirely new in power station equipment will be adopted in this plant, though what the character of these is to be has not yet been disclosed. The location is considered especially favorable for such a plant, as its relation to transportation facilities will enable the delivery of supplies to the works at a minimum cost. It has the Chicago River on one side, giving 700 ft. of river frontage, and numerous railroad tracks within a short distance on the other side. The tract on the south side of the river will be used for coal yards.

The area of the property acquired seems unusually large for such an enterprise, but past experience in Chicago has taught the necessity for providing liberally for future needs. Mr. Samuel Insull, who is President of the Chicago Edison Co., is also President of the Commonwealth Co.



Some Details—Boston & Maine Engine House.



Plan of Machine Shop and Details of Pit at Boston & Maine East Cambridge Engine House.

Road Tests of Spring and Friction Draft Gears.

We published in the *Railroad Gazette* on May 30 a report of a committee of the Western Railway Club on Underframing, which was based largely upon the results of a series of tests on the Lake Shore & Michigan Southern and the Bessemer & Lake Erie with the dynamometer car of the Westinghouse Air-Brake Co., which car was also described in the article. The report was not long, but recited the facts which lead to the conclusion that "Whatever one may think of the details of the various friction draft gears, it must be evident that, in the character and amount of resistance, they are superior to the spring gears."

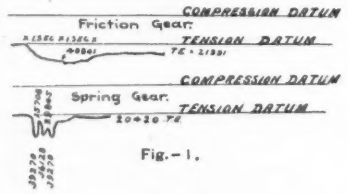


Fig.—1.

These tests were made during a period extending from Nov. 9, 1901, to Feb. 28, 1902, and consisted of 67 runs on the road and seven special yard tests. During that time the dynamometer car made 1,356 miles in 33 trips on the B. & L. E. and 2,512 miles in 34 trips on the L. S. & M. S.; occupying practically all possible positions in the trains with respect to every condition of length, weight and braked cars. The yard tests were made to obtain records of shocks in making up and sorting trains. The records thus obtained in the yard and road tests may be considered to fairly represent conditions of every-day service and to show the amount of the shocks in both buffing and pulling, which must reasonably be provided for.

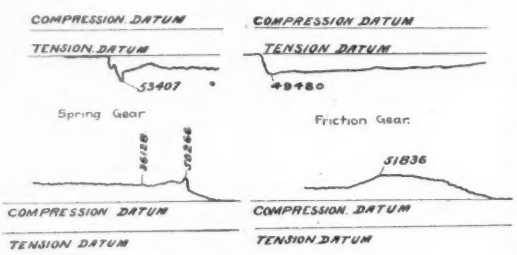


Fig.—2.

Before going farther it is well to consider the differences in methods of handling trains on these two roads. The Bessemer & Lake Erie, representing friction draft gear equipment, handles very long and heavy trains over a road full of sharp curves, sags and steep grades, and it is their practice to double-head over nearly one-third their line, using helper engines on the steepest grades. These trains, made up of large capacity cars heavily loaded, are subjected to very rough treatment, run into sags at high speed to make the next grade, "bucked" over hills and braked with much severity, yet the annual report of the road shows a remarkably low cost of repairs, proving that only slight damage is sustained. The trainmen have learned the capacity of these cars for punishment, and handle them accordingly, getting trains over the road that could not be moved by methods of running in use on roads using spring gears.

The Lake Shore & Michigan Southern, whose equipment is largely fitted with spring gears of 40,000 lbs. capacity or less, also handles long and heavy trains, but over an excellent roadbed with but light grades. Single engines of large tractive power are used, and the utmost care is exercised to prevent breaking-in-twos in starting and stopping. A recent report of breakages in draft gear on this road shows a very large percentage to occur in starting despite the precautions used. These differences in running conditions make the results of the two series of tests not strictly comparable, but most of the conclusions arrived at are based on data unaffected by these differences.

The tests were made with a view to determine if possible the amount of shocks in ordinary service, the amount of shocks in rough and extreme service, the behavior of the two types of gears within their capacity, and the behavior of the two types of gears beyond their capacity. From the results obtained in these tests the following conclusions may be drawn. That with a single engine of 36,000 lbs. tractive effort, the jerks in the middle of the train where they reach a maximum amount to about 50,000 lbs. in ordinary service; 80,000 lbs. in rough service, and 110,000 lbs. in extreme service. The records of jerks on the B. & L. E., using two engines of from 33,000 lbs. to 38,000 lbs. tractive effort each, in but one case reached 88,000 lbs., while in a number of cases on the L. S. & M. S., 110,000 lbs. was reached. This is due, no doubt, to the fact that it is almost impossible to start two engines simultaneously, and their jerks, as such, will hardly exceed that of one engine; but, of course, when both are moving in unison their joint power is entirely available. (See Fig. 3.)

In buffs the shocks amount to 100,000 lbs. to 150,000 lbs. in ordinary service, 150,000 lbs. to 300,000 lbs. in rough service and above 300,000 lbs. in extreme service. With these figures in mind it is well to remember that in no case has the spring gear a capacity greater than 40,000 lbs., and that the friction gear has a capacity of 140,000 lbs. to 160,000 lbs., significant figures. The spring gear is, as will be seen, inadequate to take care of even the ordinary shocks, and is far inferior in cushioning shocks beyond the capacity of either type.

Fig. 1 shows a comparison of the two types under nearly similar conditions. Under nearly the same pull the spring gear shows three vibrations, while the friction gear shows no vibrations, but takes care of the jerk in a smooth manner. This absence of vibration is very marked in riding on cars equipped with friction gears. Its presence with spring gears shows that it would be inadvisable to increase the present spring capacity on account of the destructive reaction which might take place in certain cases.

Fig. 2, 50,000 lb. shocks, shows the sharp peak of a blow with the spring gear, and the thorough cushioning effect of the friction gear in both buffs and jerks.

Fig. 3, 60,000 lb. shocks, note the recoil of the spring gear and the sharp peak of the blow as before. The two records of the friction gear in tension show the difference in manner of taking hold of a train with single and double-headed engines. The double-head card shows clearly the effect of the two engines on the train not taking hold simultaneously and giving a succession of jerks.

Fig. 4, 80,000 lb. shocks, permits of some explanation of the action of the friction gear, as shown by the diagram. The vibrations make a diagram apparently similar to that for the spring gear; but it will be observed that the drop does not fall to zero or below; in other words, *there is no recoil.* This is caused by the action of the friction gear in releasing. On a relaxation of pressure, the preliminary release spring relieves the pressure of the wedge on the strips. In consequence the release spring proper forces the strips back, and it does this so suddenly that the pressure is reapplied between the strips and the wedge, and again a resistance is thrown in and again released and so on until the strips have returned to their normal position. This action occurs very rapidly and is of no consequence, but it causes the release to take the form of a "shudder" as these actions occur. It is in no sense similar to the vibrations of a spring gear, for there is no recoil. There can be no recoil until the strips have regained their normal position, and this gradual relief caused by the preliminary release spring relaxing the pressure between wedge and strips on the way back tends to combat any recoiling force.

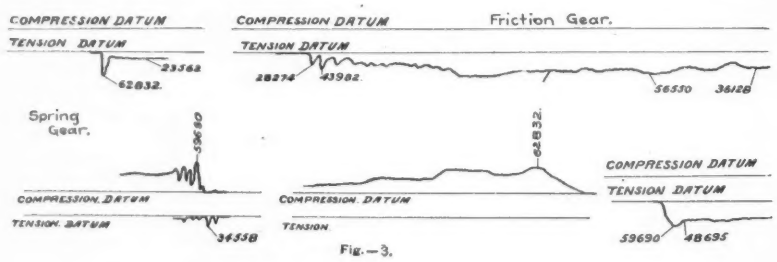


Fig.—3.

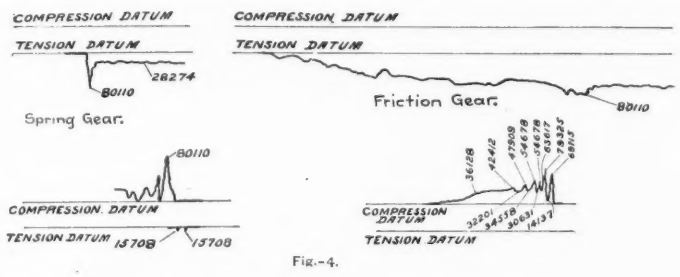


Fig.—4.

Fig. 5, 140,000 lb. shocks, shows the highest jerk recorded in any test. This was obtained by backing up a train of 42 empty hopper cars at 4.21 m. p. h. and then reversing and starting ahead on full steam. While near the capacity of the friction gear, note the absence of recoil and the cushioning effect of the friction gear in the buff cards.

Fig. 6, 300,000 lb. shocks, is a record of both gears receiving shocks far beyond their capacity, and as the friction gear is here solid, it is in the same predicament as the spring gear. Since, however, a much larger proportion of the blow has been absorbed, the recoil is much less.

The above figures have been selected to show the difference in action of the two types of gears under the same amount of registered shock, but the important fact is that a blow of a given amount will have far less effect in disturbing a train of friction gears than one equipped with spring gears. Whether or not the reactive impulses throughout a train actually assist in the start, yet it would seem that if the gears were strong enough a greater number of cars could actually be started with spring gears than with friction gears. The point is that the spring gear is not strong enough and cannot be made strong enough without getting into other difficulties. In consequence, train crews are hesitant about utilizing the full power available in starting, while with friction draft gears there is no such hesitancy, and the crews, confident of no break-in-twos, can and do use all the power available and get over the road in less time and with less trouble than where the trains are equipped with spring gears. Its use allows the loading of engines to their limit, for the heavily loaded engine is the one that makes havoc with spring gears.

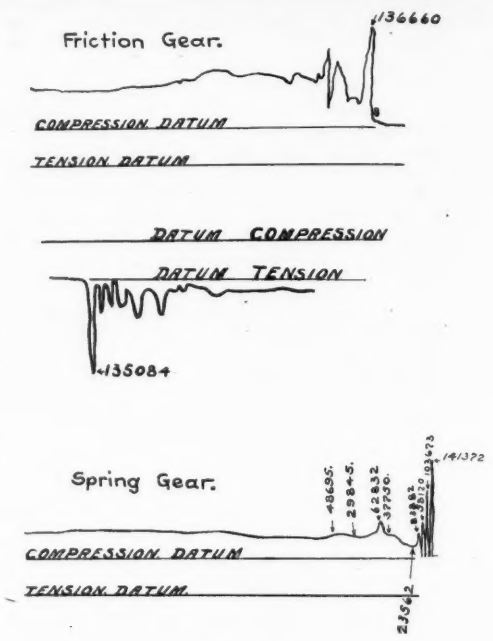


Fig.—5.

The effect of brake applications in trains with some unbraked cars is to produce pressures against the head end, varying, of course, with the weight, speed and make-up of the train. The recoil in the case of spring gears is often sufficient to part the train after a sudden application. Fig. 7 shows a record of an emergency stop at 32 m. p h. of a train of 26 loaded hopper cars, spring gears, dynamometer car fourteenth car back, with all brakes in the rear of it cut out. Air being applied to the front cars, causing their retardation, the rear cars in the train ran in, causing their draft springs to compress, massing up until the force of the "run in" was overcome. Then the compressed springs forced the cars away again; this action being repeated in gradually decreasing amounts during the whole length of stop. This waving of pressure is clearly shown in this diagram, and under certain conditions should the waves in different parts of the train meet in unison the results would be destructive.

Fig. 8 is a record of a stop with 20 lbs. reduction at 12 m. p. h. dynamometer car thirty-sixth car in a train of 75 empties, with all brakes in the rear of it cut out.

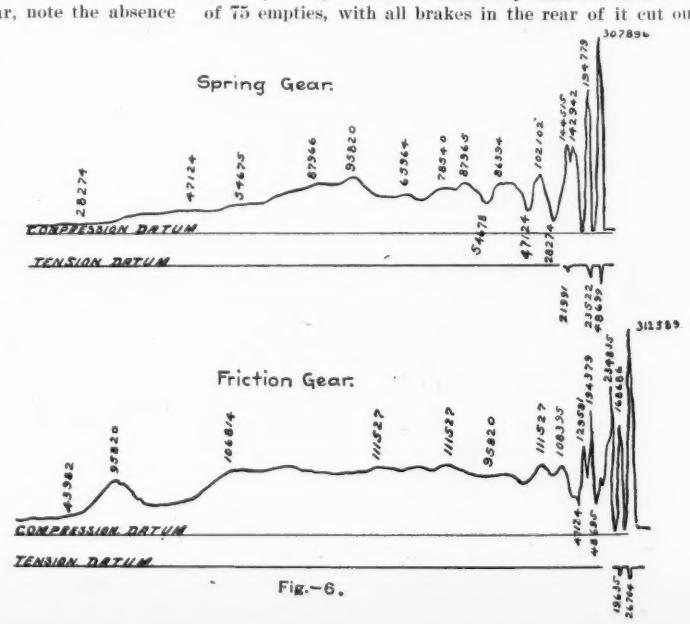


Fig.—6.

all but the last nine cars friction draft gears. It will be seen that the slack runs in with a well-cushioned blow, and then the pressure adjusts itself throughout the train with no sign of surging action. Just at the moment of stopping the rise in the co-efficient of brake-shoe friction causes a rise in the retarding effort, and the pressure runs up. This record was taken with a train of nearly three times the length of that in Fig. 7, yet the waves are totally absent. It will be noticed in the two diagrams just mentioned that the friction gear gives a smooth line denoting no internal disturbance while the spring gears show a fluctuating line of small waves, the fluctuations being less marked at the lower points of the surges. This indicates internal disturbances, due to lack of capacity of the springs.

With all the cars in a train braked, there is very little

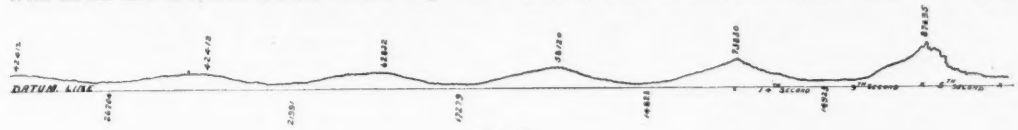


Fig. 7.

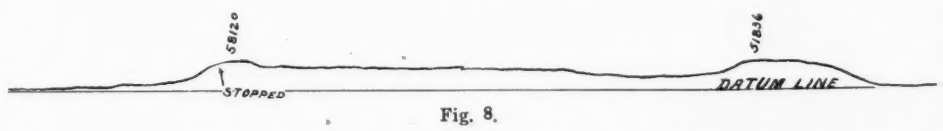


Fig. 8.

force exerted with either type of gear. Each brake appears to take hold of its own car and control that car, the brakes taking hold on the cars a little faster than the slack runs in.

Without making a comparison between the two types of gears the tests show the utter inadequacy of the spring gear of a capacity of 40,000 lbs. or less to care for even the ordinary shocks of every-day service and the tremendous stresses to which cars are subjected in extreme cases. The diagrams illustrate the effectiveness of the friction gear in taking care of shocks up to its capacity of 140,000 lbs. or beyond and its superiority in cushioning shocks beyond the capacity of either type.

Increased spring capacity alone is no solution of the problem, for the diagrams show the recoil from the present spring gears to border on the danger line, and any increase in springs means an increase in recoil on heavy blows, which is sure to be destructive.

The Superintendent of Motive Power and What Is Expected of Him.

There were some, perhaps many, of those present at the last Master Mechanics' convention who were disappointed at Mr. Vauclain's failure to appear and give them the benefit of his views as to what a Superintendent of Motive Power ought to be and ought to know, from an expert outsider's standpoint. It is probably true that there would have been absolutely no discussion of the paper because had any one contended against any of his propositions, such a one would have been considered as defending his own deficiencies.

While railroading as a profession has existed long enough for the duties required of the various officials, general managers, general superintendents, superintendents, assistants, trainmasters, accounting and maintenance of way officers, to be well understood and the training that a man must go through to fully fit himself to fill such positions successfully, is well prescribed by custom, yet the duties of the Superintendent of Motive Power have greatly changed in the last few years, and the qualifications now required of such a man are very different from what was needed in the past. This has happened in less time than it was possible to train up men to fill these places nor has the matter yet received much consideration from the technical press or from the railroads themselves.

As in other branches of the service the railroads must raise their own men and few have done this with any full regard as to all the requirements. Perhaps some younger men who have aspirations and are ambitious may be led to modify their careers so as to better fit themselves for the future, after reading the following discussion, or some railroad managers may see the importance of actually training men to fill such places even at some cost to the service to accomplish this. As far as is known to the writer, the Pennsylvania is the only road whose management has done this consistently for years, and the results should be encouraging to others when they consider how many of these motive power men have shown fitness for and have been promoted to positions beyond their department, general superintendents, general managers, vice-presidents and presidents have graduated through the mechanical department of that road. Of course, as a prominent officer once said, the civil service plan of promotion is the only proper one to encourage men in the railroad service, as long as the personal fitness is there, but Providence did not make men on the civil service plan, and when the proper qualifications do not exist in the men in line they must be set aside and allow juniors to pass them or the managers must go outside to find this fitness.

Those who have known and watched the careers of the men who have been prominent in the Master Mechanics' and Master Car Builders' Association in the last 10 or 15 years have seen many changes. Formerly the Superintendents of Motive Power and Master Car Builders were self-made men, seldom having more than a common school education. Many of them were great readers and absorbed much technical knowledge from reading the technical press and attending the railroad club meetings and conventions. They were a sterling lot of men and did immense things for the development of American railroading. Yet it can hardly be denied that their day is passing and that the technically trained men who have also had the practical experience are gradually filling the more important mechanical positions. One noticeable feature of this is in the rapid disappearance from the field of the Master Car Builder as a separate factor; his higher duties are being performed by the Superintendent of Motive Power, and his shop management is being done by general foremen, or men called master car builders, who have little more responsibility than a general foreman. Men like Mr. Chamberlain, Mr. Schroyer, Mr. Lentz, Mr. Appleyard, Mr. Hennessey and some others are becoming rare.

Now let us see what the duties of an up-to-date Superintendent of Motive Power are in a general way, and what are his responsibilities, so that we can form an idea of what he should know to be perfectly fitted and how best to get that training.

First, he must be a practical man above all things—because none but a man who has himself worked in one can properly manage a shop, know what a full day's work for a man or machine should be, nor understand how to deal with and handle men. This latter is of vital importance as a man must be able to successfully manage men nowadays, to do which he must know things himself, know when men have just cause for complaint, or when they are bringing in trumped up grievances. The only real road to this knowledge is to have done the work, know every detail of their service and know how they think and reason amongst themselves about things. They don't think things out or reach conclusions or act on lines of thought that would be natural to a highly educated man. To meet them successfully one must be able to reason things out for them in their way as well.

The Superintendent of Motive Power should also be well versed in roundhouse and shop management in both car and locomotive shops. In a rush of business the General Manager may call his attention to the fact that there is a very slow movement of the engines at some important roundhouse, and that the failures on divisions out of that house are excessive. It will not do to simply call on the Master Mechanic or foreman for an explanation; this must be had, of course, but the Superintendent of Motive Power should be able to go right to the house, watch the work for a day or a night or both, see just where the weakness of the foreman or organization lies, see what facilities are really needed, see that the best possible is being done with facilities on hand, organize and rearrange the work better if needed and bring results right there. He should at the same time by personal contact with the road foreman, engineers and firemen as they come in, get at the true cause of the excessive failures and arrange for remedies.

Further, on comparing the output of his own shops per stall one with another and with what his neighbors are doing, he finds that the work is not being done as swiftly or as cheaply at certain shops as is thought desirable. He takes it up with the Master Mechanic first, and failing to get the results he thinks necessary he should be able to go to that shop and spend some days in patient study of the conditions. After which he should be able to show the Master Mechanic how to improve the quantity and cheapen the cost of the output. Shop management is not learned from books and is a very important part of successful motive power work. Perhaps there is an unusual and vexatious run of delays from hot boxes under engines or cars or both. The Superintendent of Motive Power must be able, if necessary, to go over the line and put his finger on the real causes, generally more than one, at each point, see beyond the mere fact that a box is hot and trace the causes back perhaps to the defective shop work not very evident to the sharp but unmechanical eyes of the car inspectors, and bring results quickly.

Complaint is perhaps made that the class X engines on a certain division are making bad time and causing many failures when loaded up to their full rating, the Superintendent of Motive Power should be able to personally investigate and either make the engines or men handle the tonnage or show the General Manager a proper reason why it cannot well be done.

In this argument it is assumed that the Superintendent of Motive Power is to be such in fact as well as in name, and to handle both engineers and firemen inside of the turntable as well as be responsible for the shop management, working in harmony with and for the benefit of the transportation department. Certainly an expert, practically trained mechanical engineer is the best class of man to be in charge, if he can be had. As it is, however, on very many roads he is held more or less responsible for results, while the actual executive work is beyond his control in the hands of Division Superintendents or General Superintendents who are quick enough to find fault, but perhaps a little unwilling to take suggestions for improved methods from an officer who they consider a staff man or outsider.

Second. He must be a technical man. While on most large systems a mechanical engineer is employed sometimes entitled assistant superintendent of motive power, yet the Superintendent of Motive Power has to be responsible for the designs produced, for the specifications adopted, for the tests made, the results of which may be far-reaching in the matter of cost, and for the standards adopted and changed. He cannot afford to be at the mercy of his mechanical engineer in these matters, but just as he should be able to dictate how a shop should be run, or roundhouse handled he should be able to supervise and at times prescribe the lines that the mechanical engineer should work along, decide on how tests shall be made, whether a specification proposed is a practical one or one that will entail additional and unnecessary expense if material is purchased on it. The mechanical engineer can have full liberty to bring out his own skill and knowledge in propositions and in the carrying out of instructions, but the chief must be able to review, direct and dictate, knowing in general that the work is good. He cannot consistently unload responsibility for mistakes or extravagant practices on the mechanical engineer; when the work is adopted as standard, the chief must carry the responsibility from then on.

Indeed, without technical knowledge there are many things that he would never know were wrong or could be bettered. The chemist is becoming a more and more necessary addition to the mechanical staff. If placed under the mechanical engineer his work must come before the chief for review and an elementary knowledge of chemistry is absolutely needed to pass on reports and recommendations intelligently.

Electricity is daily coming into more general use in railroad work; train lighting, shop, depot and yard lighting installations, power plants and shop electric driving propositions will come before him for review and decision. Without some pretty good knowledge of the art how can he intelligently review such propositions? He might just as well say to his mechanical engineer: here, I don't know a thing about it, you go ahead and do what you think best.

Third. He must have a business or semi-commercial side to his training. Good, up-to-date methods of shop accounting and cost keeping or time keeping; and the handling of records and statistics for watching and getting at the true cost of operation are of the most vital importance. However good a chief clerk may be, he has usually received his training in the office only, and his methods of thought and ideas of utility of statements and comparisons do not run in the same lines as those of the men who are operating the road. Unless the Superintendent of Motive Power knows himself how all his accounts are kept and cost worked up he is apt to wake up at times to the fact that figures that he has been priding himself on for years are worthless because some part of the legitimate cost was never charged in and the statements have been misleading him.

Again, in handling the large business of the office of a Superintendent of Motive Power good business methods are of the greatest importance to get the work done rapidly and well. Clerks are usually what the chief expects of them and seldom more.

Other important features of the work of a Superintendent of Motive Power could be gone into in detail, but we can assume that the main points have been covered. Now to show those who hope one day to fill such a position that these requirements are not set too high and not unreasonable, let us take an actual day's work for a Superintendent of Motive Power of a large western system where some new work was going on both in shop improvements and equipment orders, and that as is usually the case the headquarters are also at the principal repair shops.

Commencing at 7 a.m., an hour or hour-and-a-half is spent in the shops with the Master Mechanic, general foremen and others seeing what is laid out for the day's work, and how things are going generally, looking into important details that require personal attention; then to the office to take up the morning's telegrams and telegraphic reports of service which require review, answers or investigation. The Mechanical Engineer is then waiting to consult about a number of matters which require a visit to the drawing office, where first the designs for some new cars are reviewed, alterations suggested, comparative estimates of cost of rival designs considered. Some changes of locomotive standards being under consideration these drawings are also reviewed and the cost estimates considered to see whether the gain to be expected will warrant the extra cost proposed. Then there is a question raised by the contractors building some new cars, making an alternative suggestion for construction which they claim will cheapen the cars; this has to be carefully considered to see if it will seriously affect interchange ability in repairs or the strength of the car, or if it will introduce repair difficulties.

By the time this is done word comes that the General Superintendent is waiting to see about some questions of distribution of power and tonnage rating; to get advice on doubling some runs so as to get greater engine mileage and save paying for constructive mileage if the engines and men can fairly stand it. By the time these

matters are settled several visitors are announced who require a few minutes courteous attention, or perhaps some one of them has come by appointment to take up some important question requiring considerable time. Then comes a committee of the enginemen who have an appeal to make for some brother who has been subjected to discipline; a request to make for revision of some man's seniority, standing on account of a ruling made by a master mechanic which they consider unjust, and a protest to enter against the proposed changes in the runs, claiming that this will involve hardships on

Fig. 1.—Cast Iron Rim and Flange.

the men affected. By the time all their arguments have been heard, discussed, notes taken of each case and an early answer promised after thorough investigation, one o'clock has probably come and gone.

Directly after lunch the day's mail is on the desk, the chief clerk is with it, and has a pile which he can handle himself with a few words of instruction. The mail is reviewed and such as requires further information for proper handling is passed to him for preparation. Then the stenographers are called in and perhaps 60 letters and references dictated to them alternately. In the pile will be mail of every kind imaginable and amongst it probably three or four batches of papers which require time for careful review and decision, which cannot be handled in business hours owing to the constant interruption; these are set aside for Sunday morning, or if they cannot wait, to be taken home and studied that evening.

By the time the mail is cleared away several people are awaiting audiences again and a message comes from the Vice-President saying that the entire estimate asked for a certain shop improvement cannot be allowed this year, but only two-thirds can be granted, and to let him have a revised estimate in detail by noon to-morrow. The mechanical engineer is called in with the master mechanic and a re-hash of the entire proposition has to be made. As this also requires modifications of the buildings and yard facilities the Chief Engineer has to be conferred with. By the time all the questions involved are generally decided on and given to the subordinates to work out, which they will have to do that night, darkness has come and it is already past supper time with some fresh work on the desk that has not yet been looked at.

This is no exaggerated picture. How can a man best fit himself for this great responsibility?

First go in as a machinist apprentice at 14 or 15 years of age; take night school or correspondence school during that time to advance his preparation for college as far as possible. The apprenticeship must precede the college or it will seldom come at all. Second, go to college at 18 to 19 years of age, double up on the term one year by attending summer school, and in other vacations get permission to work, without pay if necessary, in the laboratory or shops of a railroad or electrical works. Follow this by work as a machinist in railroad shops and by push, strive for a place as foreman or assistant foreman in the roundhouse or shop. Follow or precede this with a short term as fireman, or better still, road foreman of engines if the position is obtainable. Then should come some special work on tests which will sooner or later lead to the drawing office and mechanical engineer's place, or a steady line of work can be followed so as to win promotion to a Master Mechanic's place, which would be better. The rest must be acquired by constant study and absorption, by contracting a habit of keen observation, by quick assimilation of what is worthy, and by care to avoid the formation of prejudiced opinions. A pretty long and severe training, no doubt, but the qualifications to fit a man thoroughly for the place of Superintendent of Motive Power of a large railroad system cannot be acquired by any shorter cuts.

The railroads can, if they will, do a great deal toward helping young, ambitious men along this hard path, by enabling them to be at least self-supporting after they return from college, and by watching their progress and giving them the opportunities needed as they are ripe to profit by them. How many can claim to be fully fitted to hold the important positions they fill? How few have had the opportunities necessary to accomplish this, or ever had an idea when they were young men, of what would be now required of them?

In concluding this essay the writer calls the attention of those interested to the vastly greater amount of knowledge and varied experience required to properly fill the position of Superintendent of Motive Power of a large railroad than is necessary to qualify properly as the superintendent or manager of even the most important industries, and when the question is asked, is the compensation usually in proportion to the training and experience required, we are forced to answer generally speaking, no, it is not. Small wonder then that our college professors tell us that the brightest minds leaving their institutes cannot be brought to enter the railroad service, the inducements in other branches of mechanical engineering being so much more attractive for young men. The railroads need, to-day more than ever, the best talent that can be had, and they should seriously consider this question, for if left alone it will surely result in inefficient service for lack of properly qualified men to fill these important places. S.

Cast-Iron Wheels Under Heavy Cars.

The reader is well aware that for a year or two there has been pretty serious reason to believe that the chilled cast-iron car wheel could not stand the service of the 100,000-lb. capacity cars. Probably he is also aware that the *Railroad Gazette* has repeatedly expressed the hope and belief that cast-iron wheels would be found adequate for the new and more severe requirements. We are now able to bring some further information to bear upon the subject, as the results of the investigations of recent months; and, by way of preliminary, shall recite first a little of the history, to refresh the minds of those who have forgotten the exact facts.

About a year and a half ago after the 100,000 lbs. capacity car had been in service for some time there were rumors that the cast-iron wheel had been found inadequate for that service. Inquiry brought the contradictions usual when new features are introduced into railroad service. Some users declared that they were experiencing no trouble with cast-iron wheels under heavy cars; others declared that the wheel was breaking at a rate that seemed to show that it was unfit for the service. Naturally these latter regarded the situation as serious. If it should develop that the cast-iron wheel was un-

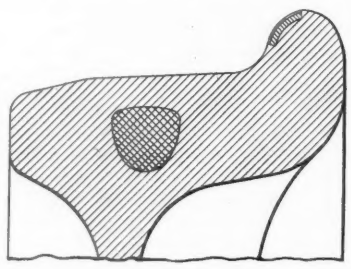


Fig. 2.

suited for 50-ton cars the reduction of car capacity or the investment of many millions of dollars in steel-tired wheels stared them in the face. From their standpoint, too, it seemed that the limit had been reached, for the wheels that were failing under 100,000 lbs. capacity cars gave no trouble whatever in the same service under cars built to carry 80,000 lbs.

An examination of the testimony showed that the trouble occurred on mountain roads, and it appeared in the form of the breakage of the flange. A crack would sometimes develop within the body of the metal and the actual rupture would show a clean fresh break all around this crack, so that no inspection, however careful, could possibly have detected it. The other party represented straight and level roads. Naturally the latter felt safe, but they were assured by the men from the mountains that it would only be a matter of time when they, too, would have failures. This did occur. Time developed a tendency for the cast-iron wheels to break in the flange under high capacity cars even on level roads. While, even before this development, cars that had given no trouble so long as they were run on the level divisions, began to break their wheels as soon as they were transferred to mountain work.

Of course officers of the roads began to cast about for a means of strengthening the wheel. The limitation of guard and wing rail distances prohibited increase in flange thickness and the necessity of securing a good chill prevented much addition to the thickness of the rim. Still, in spite of these limitations, wheels were designed that weighed from 75 to 100 lbs. more than those previously used. These wheels were put in service and with them some steel-tired wheels were used (in one case), so as to determine the commercial and mechanical value of the type in case the cast-iron wheel should fail.

These heavy wheels, while still occasionally breaking, seem to be standing up to the work in a way to relieve the responsible officials from the tension which they felt at the time of the first development of the trouble.

It is of the first importance in curing any disease to ascertain its cause, and it seems to be pretty well determined that the cause in this instance was threefold: the heating of the wheels by the brakes, the weight of the car throwing a destructive stress on the wheel on curves, and the construction of the car being such as to put an excessive weight on the side bearings, thereby cramping the trucks while running from a curve to a tangent or *vice versa*.

It will be remembered that the cracks first developed were circumferential, causing the flange to break off, as shown in the half-tone engraving of Fig. 1. This is a reproduction of a photograph of a sample showing a longitudinal seam which started at about the original base of the flange, which is worn very thin. On the original specimen there are two discolorations, one of a deep violet color and the other a bright yellow. The former was produced by the heat that started the seam, a peculiar coloring of the chill that can be produced in no other way. The bright yellow is the result of oxidation. The effect of the heat was to start the crack, which extended longitudinally by service, the oxidation naturally following.

This specimen was used as a motor wheel on an electrically driven car, and this defect is quite common with them, especially at seasons of the year when the wheels slip a great deal. It is a defect that is common to all chilled cast-iron wheels and takes place regardless of the mixture, when they are subjected to certain conditions of service.

In commenting upon this peculiarity of fracture a wheel maker writes: "Wheels under cars of 100,000 lbs. capacity are subjected to very severe strains and excessive brake action. The resulting defects are broken and cracked plates, cracked brackets and broken treads and flanges. The tread and flange fractures are due principally to longitudinal seams caused by the heating of the rim of the wheel, either through the excessive use of the brake or from the friction generated by the constant grinding against the rail.

"The chill of the wheel is composed of crystals, which are radial to the plane of the chill mold in which the wheels are cast. The chill crystals can be separated in the same way that wood splits with the grain or stone by its cleavage, and they are more easily separated by the action of excessive heat or friction than by any other means.

"Until the introduction of 80,000 and 100,000 lbs. capacity cars and the very heavy tenders now in use, it was a rare thing to see a longitudinal seam in a chilled wheel. Now they are quite common. They are solely incident to the service, as they are never found in breaking up new wheels, and they generally start at the base of the flange and are much more in evidence when the flange is considerably worn than when it is in its normal condition.

"This defect has been known to occur in a wheel on one end of an axle, which was worn 'sharp flange' where the wheel on the other end made from the same pattern, by the same moulder, on the same day and poured from the same ladle of iron was perfectly free from the defect. It is not intended to convey the idea from this that the defect does not occur when the wheel is not worn 'sharp flange.' It may occur when the flange shows comparatively little wear if it has been heated sufficiently by brake action or from constant grinding against the rail to crack the chill crystals. These longitudinal seams in their incipiency may not be more than 1 or 2 in. long, but the weight of the load and impact will cause them to gradually extend until the flange is so weakened that some severe lateral thrust will cause a piece to break out."

It is evident from this that the longitudinal cracking of the treads is a very serious matter, but the improvements that have been made during the past two years have relieved this trouble to a great extent, though it has appeared in a somewhat different manner. In the heavier wheels that are now being used, the cracks appear normal to the tread and parallel to the axle, in exactly the same way that they do under wheels subjected to the heat test. These cracks are not as dangerous as the others, but they, nevertheless, serve for the condemnation of the wheel.

Unfortunately the records are not in such shape as

Fig. 3.—Steel Wheel, Rim Split.

to enable one to come to a conclusion as to what the final results will be, beyond the fact that apparently the old 625 and 650 lbs. wheel will not serve for 50-ton cars. In a series of reports, taken at haphazard in May of this year, out of 137 wheels removed for cracked tread and flange, 89 were under cars of 100,000 lbs. capacity. It is known that the majority of them were of the old and light pattern.

Naturally there is still a difference of opinion. Some regard it as by no means settled; others consider themselves out of the woods. Some regard the cast-iron wheel as capable of still further improvement so as to

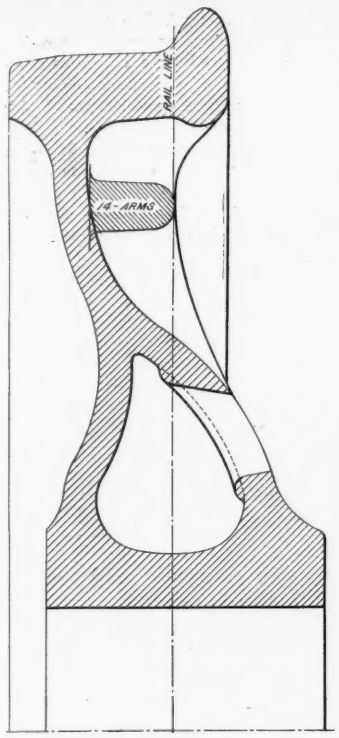


Fig. 4.

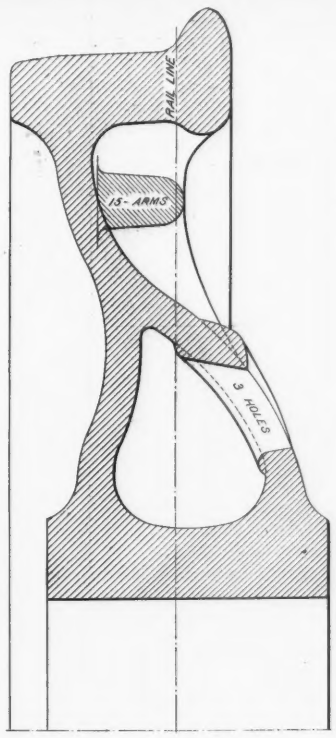


Fig. 5.

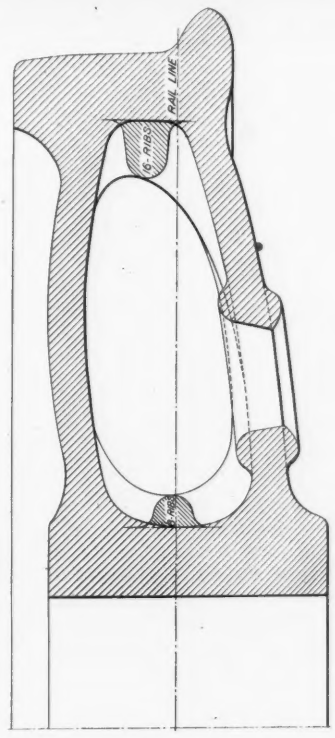


Fig. 6.

be able to meet the requirements of a car of higher capacity than those in use, while some foundrymen acknowledge that they would not care to undertake to make a wheel to carry a car of 120,000 lbs. capacity. On the whole, there seems to be confidence in the ultimate success of the cast-iron wheel.

The slight experience that has, thus far, been gained with steel-tired wheels under these cars is somewhat curious. The treads frequently shell out like cast-iron wheels, and in a way that is quite new. It is also considered that the tire fastening is not what it should be, but the mileage is, as yet, too short to come to a final conclusion as to their value. It will probably be two years before there will be unanimity of opinion regarding what may be expected from either cast or steel-tired wheels in this heavy service.

Some of the investigations have resulted in interesting developments. Thus, it was found that cracks frequently occurred in the body of the metal of the rim like the sketch Fig. 2, in which the double-hatched portion represented the cracks. No inspection would have detected such a defect. It was attributed to brake action in which the tread expanded and put such a tensile stress upon the gray metal beneath as to crack it. This has been demonstrated as the true cause by producing the same sort of a crack artificially. A wheel is placed in the sand as for a heat test, but instead of pouring 1½ in. of metal about the rim only ¼ in. is used. This expands the tread but has not body enough to heat the whole rim, so that the expansion of the outside is sufficient to cause tension enough to crack the interior. A similar action takes place in the brake application on long grades by which the tread is heated and internal and external cracks, normal to the flange, are produced.

Another defect has been developed in the steel-tired wheel which may serve to explain some of the internal circumferential fractures of those of cast-iron. This occurs when the tire of a fused steel and cast-iron wheel is worn down very thin. The rolling out of the tire puts it under great compression which, in turn, puts a tensile stress on the cast-iron beneath with the result that a fracture may take place like that illustrated in Fig. 3, where two portions of the rim are separated by about ⅜ in. A similar phenomenon can very possibly occur with the cast-wheel. Such an effect as this serves to emphasize the necessity for a tire fastening of the first order.

It must not be understood that the work done on cast-iron wheels has been limited to the mere addition of weight. A slight change has been made in some places in the mixture by increasing the amount of charcoal pig from 15 to 20 per cent. As far as chemical analysis is concerned little can be done because that is defined within rather narrow limits by the necessity of securing a suitable chill. Improvements can, however, be made by care in the annealing whereby a greater uniformity in the output can be obtained and, in some cases, double annealing has been resorted to. This will make a wheel capable of withstanding the thermal test which would otherwise fail under it, and is, therefore, regarded as of great benefit.

In order to show just what has been done in gaining additional strength by a change of form and increase of weight, a few examples of the old forms of wheel used under cars of 60,000 lbs. capacity are given together with those designed by the same makers with an increased weight and designed for service under cars of 100,000 lbs. capacity.

Figs. 4, 5 and 6 show sections of wheels that are made by the Lobdell Car Wheel Co., of Wilmington. Fig. 4 is the section of the 600-lb. wheel generally used under cars of 60,000 lbs. capacity. The bracket, whose section is shown by the fine cross-hatchings, is cut back from under the flange in the ordinary way. Attention is called to this matter because of the change that has been made in this respect with the heavier wheels. There are 14 of these brackets in the wheel.

The next step in advance is the wheel shown in Fig. 5, which was designed for a special purpose and as a sample order to be placed under some cars of 80,000 lbs. capacity. The principal change was in the number and thickness of the brackets. The number was increased to 15 and they were made 1¼ in. thick instead of $1\frac{3}{16}$ in. The under cut beneath the flange was also less, having been diminished from $1\frac{5}{16}$ in. in Fig. 4 to $1\frac{3}{16}$ in. in Fig. 5. The thickness of the plates was kept the same and the shape was not altered. Any one familiar with the value of the brackets to the strength of the wheel will readily understand that there was considerable increase in this respect by the change indicated in the bracket. The weight of the wheel, so changed, was 650 lbs.

In Fig. 6 we have a wheel of an entirely different section and composed of two plates, the inside one backing up the flange and giving it some support even in case of a crack, like those mentioned as developing. The double-plate wheel is no new thing, but one of this weight was not called for when the cars were lighter. The two plates are connected by 16 internal ribs at the rim, of which eight extend around the whole of the core as shown. These are of the shape shown by the fine cross-hatchings on the engraving. They are $1\frac{1}{16}$ in. thick and swing off into the body of the metal with generous fillets. The weight of these wheels is 725 lbs. This wheel will be recognized as a modified form of the old Bush & Lobdell double-plate wheel used many years ago, and it has been revived for use under cars of 100,000 lbs. capacity, for which it seems to be well adapted.

Figs. 7 and 8 show sections and quarter back elevations of the wheels that are being made at the wheel foundry of the Pennsylvania Railroad at Altoona for cars of 60,000 and 100,000 lbs. capacity respectively. The difference between the forms of these wheels is quite as marked as in the case of the single and double-plate wheels of the Lobdell Car Wheel Company. The wheel

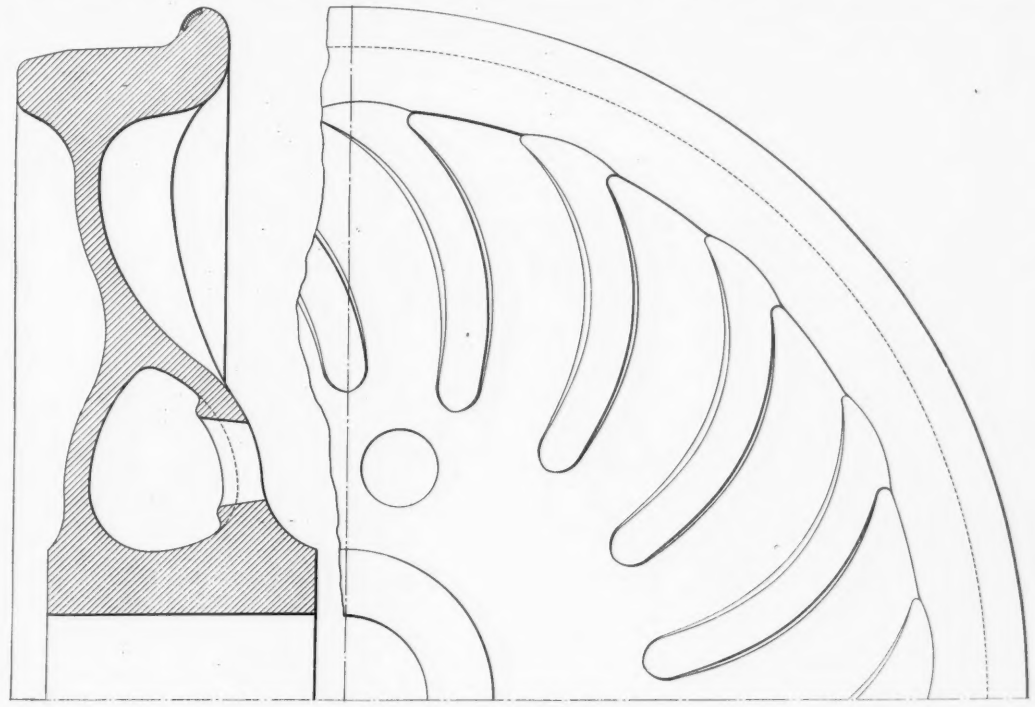


Fig. 7.

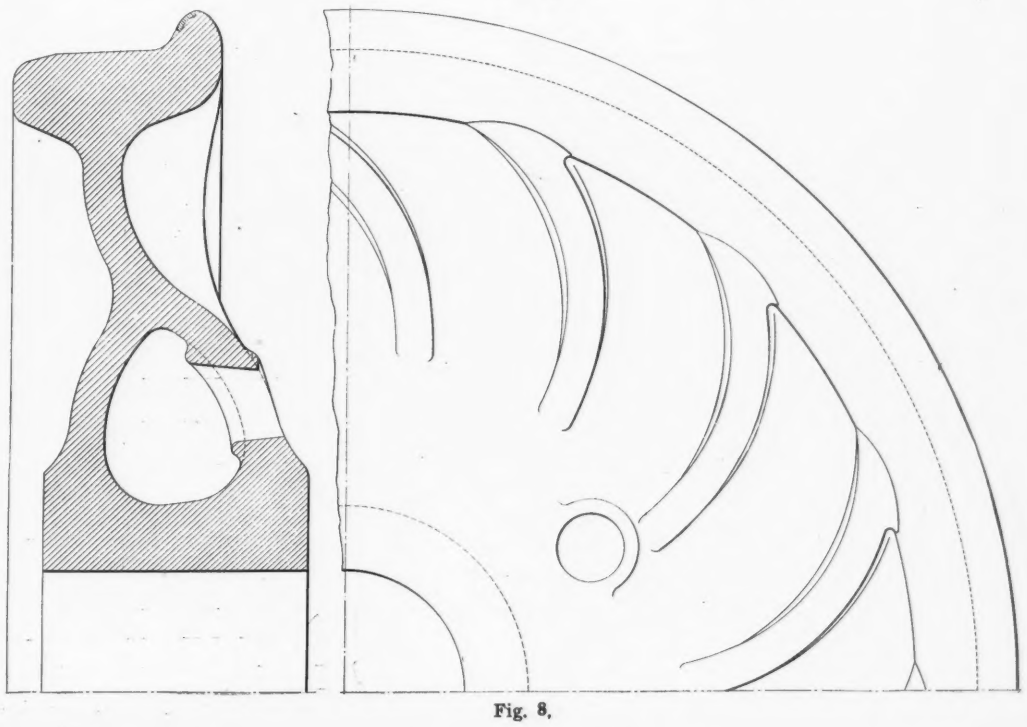


Fig. 8.

shown in Fig. 4 weighs about 625 lbs. and has given perfectly satisfactory service under the cars for which it was designed. There are 14 brackets curved as shown in the rear elevation. Their thickness is about 1 1/16 in., while that of the plates is 5/8 in.

Comparing this wheel with that used for the cars of 100,000 lbs. capacity we find a notable difference. Aside from the increase in the diameters of the hub due to the increase in the size of the axle used, there has been a marked thickening of the plates and a change in the shape of the brackets. The double portions of the plates are 15/16 in. thick, and the single section has been increased to 1 in. The number has been kept the same, at 14, as in the case of the lighter wheel, but the undercut beneath the flange at the back has been decreased from 1 3/8 in. to 7/16 in. The thickness of the bracket also averages a little thicker, but not enough to make any material difference in the weight were the other changes not taken into consideration. The weight of these wheels is about 725 lbs.

It will be seen from these illustrations that the wheel for the heavy cars has been made and strengthened without adding anything to the thickness of the rim, so that the chilling qualities of the tread are not impaired in any way, and there is no reason why such a wheel should not give as good service under the high capacity cars as that now obtained under those of 60,000 lbs. with the lighter pattern, barring the more rapid wear to the tread that must inevitably take place due to the greater stress and grinding to which it will be subjected on account of the increased weight which it will be called upon to carry.

While it may even now be premature to say that the wheel for the car of 100,000 lbs. capacity has been found, it is evident that much of the perplexity and anxiety pertaining thereto has been removed. So, even though the cast-iron wheel of ordinary make may continue to fail under the heavy stresses imposed by these cars, we are not warranted in taking such a view of the situation as to condemn the wheel for the purpose and to put its limit of usefulness at cars of 80,000 lbs. capacity. But, in view of what has happened under these excessive weights, the careful man will look well to what he is using and make sure that the cast-iron wheel is made under due precautions as to material and design before another advance is made, and the nominal capacities of the cars, under which it is to be used, are raised to 110,000 and 120,000 lbs.

Repairing Locomotives by Schedule.

In our issue of April 11 brief mention was made of the scheme in force at the Chicago shops of the Chicago & North Western for repairing locomotives by schedule. As stated at that time, the new system was inaugurated last summer, and the results have proved so very satisfactory, we are presenting a detailed description of the plan, together with one of the schedules.

The idea originated with Mr. G. R. Henderson, at that time Assistant Superintendent of Motive Power, and Mr. O. Otto, General Foreman, and was worked out by them. It was the outgrowth of an effort on the part of the motive power department so to systematize the work in the shops that, knowing the nature of the repairs an engine must undergo, the length of time it must be out of service may be known to a day. Since profitable operation demands that all engines be in service as much as possible, it is a great advantage to the motive power and operating departments to be able to know, when an engine is taken into the shop for repairs, just when it can be depended upon for service again, and further that the time it will remain out of service has been reduced to a minimum. It seems to be a peculiar fact, and one of which all shop men are aware, that the longer an engine remains in shop for repairs of a given nature, the greater the cost of these repairs. In other words the time element apparently affects the cost of repairs, even though their extent remain unchanged.

The plan followed before the present one went into effect was probably the same as is employed in a majority of the railroad shops of the country; that is, when an engine was taken into the shop, its number, time in, and probable time out of shop were chalked on a board, the time required being the foreman's estimate which, all conditions being favorable, would no doubt be fairly accurate. But at its best there is a large element of uncertainty in such a method, as apparently unavoidable delays are constantly occurring to increase the time.

The successful working of this schedule system is due to two things, viz., systematic co-operation of the various departments, and careful and systematic providing ahead. To make the latter clear one of the features of the system must be explained. Cards about the size of a postal card printed in blank are issued to the various Master Mechanics, and so arranged as to have entered on one side the engine number, class, division, and kind of service; also number of miles made since last general repairs, when engine should go to the Chicago shops, and the nature of repairs needed. An engine is supposed to make 200,000 miles between general repairs, barring accidents, though the average probably comes nearer 150,000. Master Mechanics are required to send these cards into the shops three months ahead of the next general repairs period. They are kept on file in three separate lots, representing the number of months still intervening before the engine must be taken out of service. The first lot has one month, the second two, etc. Each month the cards are moved over to the compartment representing the next lower number of months. This arrangement enables the department to provide ahead for the necessary stock for the repairs.

When the three months have expired the motive power department orders the engine to the shops. The rest of the record is kept on the reverse side of the card, where there are blanks for the engine number and class, time ordered to the Chicago shops, time of arrival, when taken in, when ready for service, what division sent to, and remarks. These cards are then filed away, serving as a brief record for each engine.

There are three different schedules embraced in this system, for three different classes of repairs. The first is for general repairs and half side sheets or fire-box, the time allowance being 21 days; the second, for general repairs, has 16 days; light repairs is the third, and is given eight days. We reproduce the long schedule, an examination of which will show how the work of the various departments is timed, so that each one carries forward its portion in agreement with other departments with which it must co-operate. Each line represents a day and the entries for the various parts show the day on which that particular part must have the work completed ready to move on to the department awaiting it. Referring to the tank shop, it will be seen that the tender is required to be completed on the eleventh day. This is in order to move it to the paint shop and have it ready for service on the 21st, day when the engine must be turned out. The General Foreman must use his judgment as to the amount of each kind of repairs the shop is ready to handle, and not permit too many of one kind to be run in.

The schedules are prepared in blue print form, mounted on a suitable board and placed in the offices of the General and Department Foremen. Instead of using a separate schedule sheet for each engine, in the office of General Foreman individual records are kept on separate slips held in a clip at the left-hand side of the schedule. These slips, which are Van Dyke prints, are about 3 in. wide and are ruled in agreement with the schedule horizontally, and have three vertical columns, one for each of the three classes of repairs. The dates on which the various kinds of work must be completed are entered in that column corresponding to the kind of repairs the engine is receiving. These slips also have the engine number and class entered at the bottom.

At the beginning of each week the General Foreman makes out a report showing the number of engines in the shop, with dates in and dates out; the number turned out the week previous with nature of repairs; engines in the boiler shop, giving dates in, dates out, and kind of repairs; engines delayed after schedule time; engines to be limbered up during the week; engines put in service the week previous; and engines on the "hospital track," giving number, class, division, date on track, and nature of repairs. The "out" engines are shown for the month; that is, on the report for any one week the output for the previous weeks of that month are shown, so that the report for the last week in a month shows the output for the entire month.

On Monday morning of each week a meeting is held to discuss conditions. The General Foreman is chairman of this meeting at which are present the Department Foremen and Floor-gang Bosses; the store house and drafting room also have a representative each, the former to supply information or discuss matters concerning stock and material, the latter to receive for his department any recommended changes and to take part in the discussion of same. After disposing of unfinished business the in-and-out report for the previous week is discussed and if any engines have been delayed after the schedule date, the cause is inquired into and the possibility of preventing a repetition of the occurrence considered. However, it should be said that such delays have become exceptional and probably 90 per cent. of the reports show a clean sheet under this head. What delays do occur are mostly a result of having to wait for material.

In working out and arranging the schedule, the opinions of the different foremen were obtained as to the minimum time required for the various operations. In many cases these were considered too liberal and were cut down.

SCHEDULE OF WORK FOR ENGINE NO. ——GENERAL REPAIRS AND HALF SIDE SHEETS OR FIRE-BOX.

Erecting Shop.	Boiler Shop.	Machine Shop.	Smith Shop.	Tank Shop.	Carpenter Shop.	Paint Shop.
Engine Taken In.						
Stripped and to B. Shop.	Boiler in Shop.					
			Valve Yokes.			
			Brake Work. Frames.			
Cylinders Bored.			Tender Springs.	Trucks Completed.		
		Brakes, Valves and Yokes.	Rods and Straps.	Frame Completed.	Cab Repaired.	
				Tank Repaired.	Tender Work.	
Steam Chests and Valves Up.			Guides and Yokes.	Tender Completed.		
		Frames Finished.				
	Fire-box Repaired.	Driving Boxes Fitted. Driving Wheels Ready. Shoes and Wedges.	Spring Rigging.			
Boiler Returned.	Boiler to Erecting Shop.	Eccentric Straps and Rods.	Truck Springs.			Cab Painted.
Frames Up. Steam Pipes In.		Crossheads and Guides.	Driving Springs.		Back Running Boards Up.	Wheels Painted.
Truck Ready. Cab Up.	Flues Reset.	Links.				
Wheels Under-spring Rigging Up.	Boiler Tested.	Pistons and Rods.			Pilot Repaired.	
Boiler Lagged. Boiler Jacketed.		Main Rods.		Smoke-box Work.	Front Running Boards Up.	
Piping Up. Valves Set.		Side Rods.		Ashpan Up.		Tender Painted.
Completed and Painted.						
						Engine Completed.

The Twenty-one Day Schedule for Locomotive Repairs—Chicago & North Western Railway.

(The Blue Print for shop and office use is nearly twice this size.)

There have been very few changes made in the original form, and these have in every case been in a reduction of the time allowance. It required some little time to get the shop forces organized up to the proper pitch, but once accomplished, everything has run smoothly and efficiently, as shown by the few delays. There are 21 pits available for use, apportioned to four gangs, one of which has an extra pit. The weekly reports show the number of engines handled by each gang.

One most important essential to the successful working of a schedule system is in the keeping constantly on hand a sufficient stock of finished material. This material should be ready, as nearly as possible, to go on the engine.

The records of the North Western shops have shown a steady increase in the yearly output of engines without any increase in the rolls. This is, of course, largely due to improved tools and machinery, but also to the shop organization. At the present time the monthly output averages 32 engines, with April as the banner month, having 33 to its credit. It is expected that the number will be increased to 35 as soon as improvements now under way are completed.

Two elements only serve to disturb the smooth working of the schedule. The more serious of the two is wrecks; the other is defects undiscoverable prior to stripping. The requirements for repairs of a wrecked engine cannot be covered by any schedule as no two cases are exactly similar. If the engine is in important service it is given immediate attention; otherwise it is permitted to await its turn.

Some Modern Draft Gears.

[WITH AN INSET.]

THE WESTINGHOUSE FRICTION DRAFT GEAR.

This gear was described in the *Railroad Gazette*, March 2, 1900, page 133. The drawing given here shows its application to a car with steel underframing. The parts are: 1, yoke; 2, followers; 3, draft spring; 3a, release spring; 4, gear case; 5, wedge block; 6, friction strips; 7, cheek plates riveted to sills; 8, lower yoke guide; 8a, upper yoke guide.

THE O. AND C. DRAFT RIGGING.

This gear utilizes the friction between the plates of four elliptic springs each composed of six plates of ⅜ in. steel. These springs, which are the only ones used in the device, have a total capacity of 125,000 lbs., with a movement of the followers of 2 in. in either direction. By dropping the tie plate 8, the gear may be easily removed. The parts are: 1, yoke; 2, followers; 3, spring; 4, spring case and cheek plates; 8, tie plate.

THE M'KEEN FRICTION DRAFT GEAR.

The McKeen gear consists of the following parts: 1, yoke; 2, followers; 3, draft spring; 3a, friction springs; 4, spring case; 5, wedge spindle; 6, wedge blocks. In pulling the compression of the coil spring 3, forces the wedge spindle 5 between the wedge blocks 6, giving a graduated resistance. In buffing the leaf springs are compressed, flatten on the cheek plates, push the small followers up to the stop and compress the coil spring at the same time, thus obtaining maximum friction in gradually increasing amounts.

THE SESSIONS FRICTION DRAFT GEAR.

See *Railroad Gazette* Nov. 29, 1901, page 818, for full description of this draft gear.

THE MINER DRAFT GEAR.

This is a tandem spring gear and is shown as applied to steel underframing. The parts are: A, cheek plates; B, yoke; C, draft spring; D, followers; E, filler block riveted in the yoke between the two center follower plates; F, liner blocks on coupler. The springs are triple coil, 9¼ in. long. A movement in either direction of the coupler causes the block E to force one of the center followers in the same direction and the same distance as the end follower moves, distributing the load equally on the two springs. The filler blocks F are required on account of the increased opening of the yoke.

The O. and C. Friction Draft Gear Arranged for Test.

THE DAYTON DRAFT GEAR.

For a description of this gear see the *Railroad Gazette* May 17, 1901, page 329.

THE BUTLER DRAWBAR ATTACHMENT.

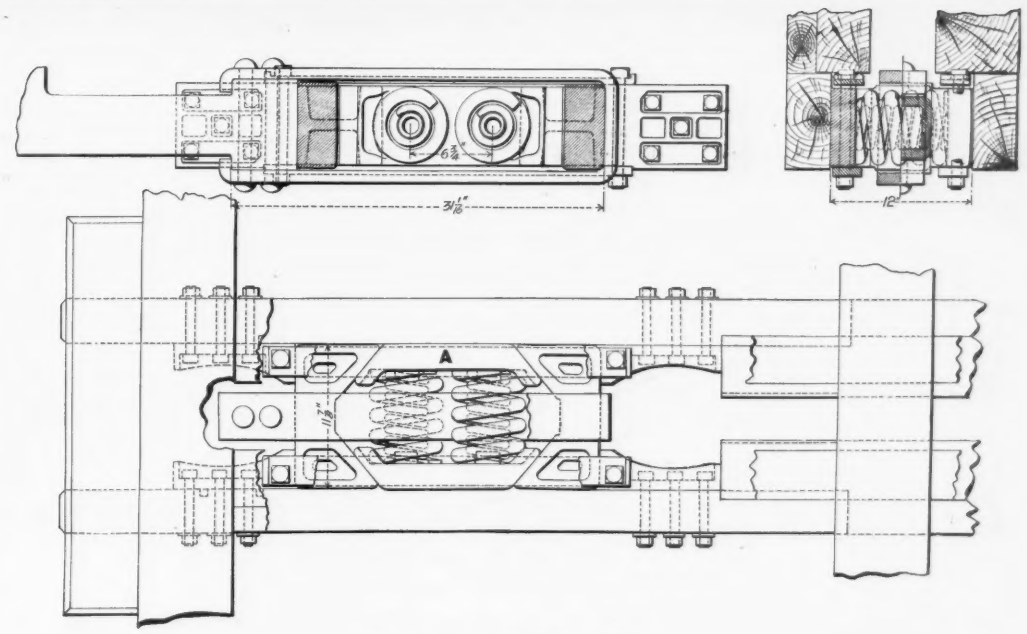
This consists of, 1, yoke; 2, followers; 3, draft springs; 4, spring case; 5, plunger; 7, cheek casting. Two M. C. B. springs are used, the rear one encased in a cover, 4, which is a combination of rear follower and stop for the center follower. In tension the case 4 is forced forward by the yoke and in turn forces the center follower 2, compressing both springs. In buffing, the front follower compresses the forward spring and at the same time forces the plunger 5, back, compressing the rear spring.

HIEN FRICTION DRAFT GEAR.

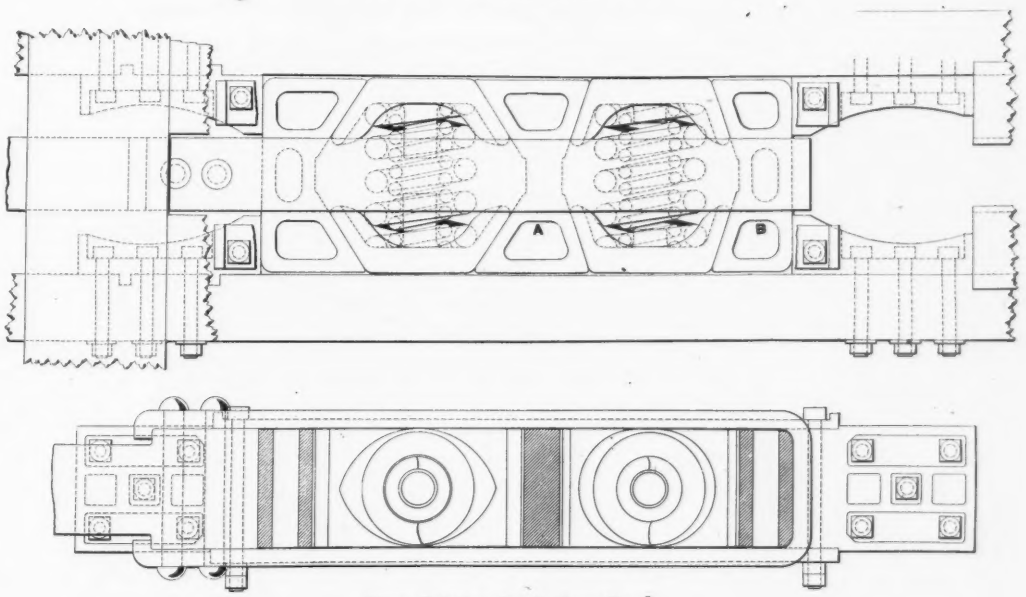
This gear consists of a malleable iron case, A; two malleable followers, B; two malleable spring plates, C, and two sets of malleable friction plates, D, six plates to the set; a standard M. C. B. spring, E; a wrought-iron yoke, F, and a malleable thimble, G. The yoke opening is 7¾ in., or 1¼ in. greater than the M. C. B. standard. The friction-plate surfaces have no finish except grinding. It will be noted that the top and bottom plates are shorter than the intermediates. This is in order to enable the follower and spring plate, by means of the bosses shown to come in contact with two successive plates having motion in opposite directions, as contact with one alone would tend to crowd these parts against the side of the case as the plates move. The edges of the friction plates in contact with the inclined sides of the case are increased in thickness to give greater frictional contact. As shown by the drawings, the two ends of the friction gear are duplicates. A buffing or tensile stress forces the follower against the stops. Assuming a tensile stress, the front follower being in contact with the stops, the yoke bears against the rear follower, crowding the friction plates against the spring plate and compressing the spring; at the same time the friction plates move on one another. Similar action occurs with the front follower and friction plates, giving the frictional resistance of the 10 plates on each other in addition to the spring resistance, to absorb the shock and recoil.

HINSON'S AUXILIARY FRICTION DEVICE (CLASS F).

This device is applicable to ordinary spring gears and is shown attached to a Hinson single spring gear. The parts, including the spring gear, are: 1, yoke, wrought-iron; 2, spring followers, crucible steel; 3, cheek casting, steel; 4, friction plate, grey iron; 5, spring pocket with friction plate, cast-steel; 6, oscillating links, cast-steel; 7, yoke clevis, cast-steel; 8, chafing irons, grey iron; 9, tie straps, wrought iron. The friction plate, 4, is bolted rigidly to the draft timbers. The spring pocket with friction plate, 5, moves with the yoke, being attached to it by the yoke clevis, 7. Motion of 5 in either direction causes the oscillating links, 6, to swing, thereby increasing the friction between 4 and 5 by means of spring 10.



Piper Friction Draft Gear No. 1.



Piper Friction Draft Gear No. 2.

HINSON'S TANDEM SPRING GEAR (CLASS B).

The parts of this gear are: 1, yoke, wrought iron; 2, cheek plates, cast-steel; 3, springs, M. C. B. standard; 4, spring followers, crucible steel; 5, front and back followers, wrought iron or cast-steel; 6, detachable bar, cast-steel; 7, chafing irons, grey iron. The detachable bar, 6, is to enable the speedy removal of the springs and follower plates, by simply removing one of the bolts through the ends of the bar and dropping it down.

HINSON'S COMBINATION TWIN-SPRING AND FRICTION (CLASS C).

Memorandum description in *Railroad Gazette* December, 1901, page 844.

THE PIPER GEAR.

Piper Friction Draft Gear No. 1 is composed of four steel castings, including one rear and one front follower, and two wedges or side followers; also two Standard M. C. B. 6¼ x 8-in. springs. Stop posts or lugs are attached to the wedges or side followers, which prevent the springs from ever becoming solid. The friction surfaces are planed at an angle of 45 deg. and permit a movement of 2 in. The gear is 25½ in. long.

Piper Friction Draft Gear No. 2 is composed of seven steel castings, including one front, one middle or floating follower, one rear follower, and four wedges or side followers; also two Standard M. C. B. 6¼ x 8-in. springs. Stop posts or lugs are so arranged within the springs and attached to the wedges that the springs never become solid. This gear has its friction surfaces planed and has a movement of about 2½ in. The gear is 30 in. long.

THORNBURG DRAFT GEAR.

We have received, too late for publication this week, drawings of the Thornburg Draft Gear. These will be published with a description of the device in our next issue.

The Davis Solid Truss Brake-Beam.

It is the law of averages that the sum of the excesses is equal to the sum of the defects. In modern metal brake-beam construction, there are, broadly, two systems of design which are generally followed. One method employs a heavy, rolled shape, and has a minimum of parts; while the other uses a lighter section of steel, and relies for the necessary stiffness on a greater number of parts, so disposed as to best withstand service stresses. The former has the advantage of having few parts to fail, work loose, or be lost, and maintenance is simple. To do this the beam must be comparatively heavy, or perhaps must have the metal so disposed as to occupy valuable space. The lighter beam, trussed, is sufficiently stiff, but

Fig. 1.

Fig. 2.

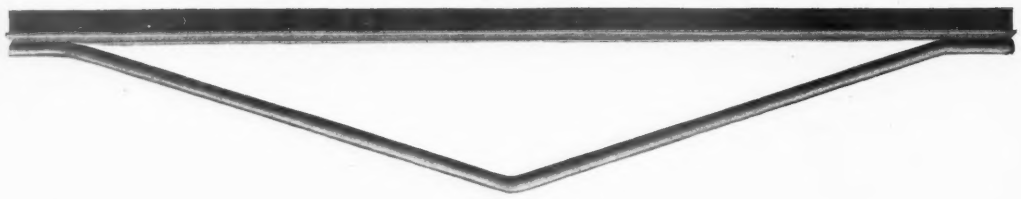
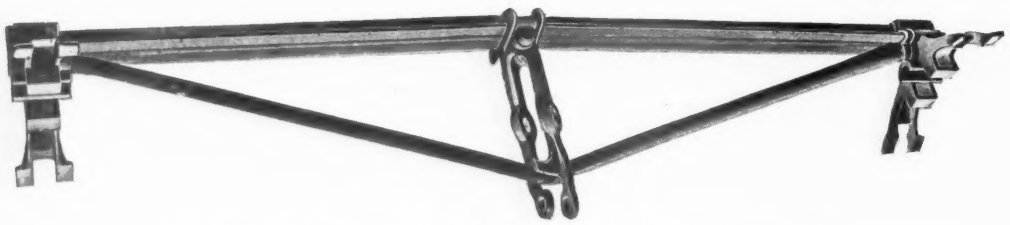


Fig. 3.



Four Stages in the Construction of a Davis One-Piece-Truss Brake-Beam.

it usually has a number of fittings or parts, held together by nuts, keys or rivets. These may work loose or fail in one way or another. The application of the law of averages, points to the conclusion, that generally, advantages secured in any ordinary form of construction are likely to be more or less counterbalanced by disadvantages. It is therefore the aim of good design to upset as far as possible this law of averages, and to retain the positives, and to minimize the effect of the negatives.

The Davis Pressed Steel Co., of Wilmington, Del., submits its latest design of brake-beam to criticism, and to tests. The steel out of which its brake-beam is made is a rolled shape of peculiar form made from soft steel,

Davis Malleable Strut and Head.

.066 per cent. carbon, with a tensile strength of 59,905 lbs. per sq. in. It is a ⊥ section with a round bar attached to the under side. (Fig. 1.) The sizes of this mild steel section are approximately, round head 1-in. in diameter; neck, ⅜-in.; arms, slightly tapering, about ¼-in. (mean); and body, ⅜-in.; with ample fillets at all corners. The bars, as rolled, measure 67¼-in. in length. In the process of manufacture into brake-beams, when heated to the required temperature, the bars are each placed in a specially designed shear, which cuts the round head off smoothly all along, with the exception of 4-in. at each end of the bar. (Fig. 2.) The bar, while hot throughout its length, is upset 3-in., and this has the effect of bowing out the circular bar, which viewed in section, we have called the round head. (Fig. 3.)

This brake-beam is then, practically a tee-bar in section, with a round truss rod, whose ends are a part of the beam ends; having been rolled in one piece and never having been severed. A suitable malleable iron strut, carrying the brake-lever, is interposed between the center of the tee and the truss rod, whose ends form an integral portion of the beam.

This description of the process of manufacture has probably indicated the principal claim which the Davis Company make, which is that its brake-beam is of light, strong, rolled steel section, which possesses a truss rod, giving it the required stiffness, and that the method of attachment being permanent, and so to speak, born with the bar, the most complete reduction of parts and attachments has been secured.

The beam is slightly cambered, and as these beams are all machine-made the amount of camber in each beam is the same and the tension put upon the truss rod by the introduction of the strut is uniform.

The idea of thus using a light section of steel, and at the same time, as it were, splitting a truss rod out of the solid piece, without attachments or loose parts, is due to Mr. Nathan H. Davis. Mr. Davis is the pioneer in the manufacture of pressed steel shapes, and this brake-beam is the result of large experience.

The malleable iron brake heads used are of the M. C. B. standard Christie pattern, which are pressed on the end of the beam, and are secured by two rivets each, passing through the horizontal web of the tee. The strut is made in two pieces, designed for strength and lightness, which fit closely together, with locking catches at each end. This composite strut is held in place by a rivet which causes the two pieces to bite on the tee section, while the locked outer end grips the center of the truss rod.

A test of this brake-beam, recently made, showed that a pull of 27,700 lbs., applied at the brake-lever fulcrum, and resisted by blocks placed against the brake-shoes, slightly stretched the truss rods, and reduced the camber of the brake-beam by nine-sixteenths of an inch; the original camber having been 1⅛ in. Aside from this loss of camber, the beam was uninjured.

Western Steel Car & Foundry Company.

In a recent issue we noticed the incorporation of this company in New Jersey with a capital of $1,250,000. The final organization of the company was completed in New York, June 5, and the transfer of the Chicago works of the Illinois Car & Equipment Co. was made. At a meeting of the stockholders, the following directors were elected: F. N. Hoffstatt and A. H. Larkin, New York; J. W. Friend, Pittsburgh; A. C. McCord, Chicago; D. W. McCord, New York. The officers chosen are: President, A. C. McCord; vice-president, D. W. McCord; secretary, A. H. Larkin; treasurer, P. G. Jenks; auditor, S. E. Moore. It is said that a large amount of money will be spent upon the works immediately for the purpose of equipping it for building steel cars and wooden cars with steel underframes. The headquarters of the company will be in Chicago.

On the night of Wednesday, June 4, at the plant of the Illinois Car & Equipment Co., the planing mill and woodworking department having an individual power plant, were completely destroyed by fire, entailing a loss of approximately $75,000 to building, machinery and materials. Arrangements have been made for the early temporary operation of the department, it being the expectation that the building of cars may be resumed within two or three weeks. Plans are being made for a new and enlarged building for which new machinery is already being purchased. The fire loss was fully covered by insurance.

The Structural Steel Car Company.

THE WORKS AT CANTON, OHIO.

The Structural Steel Car Company, as its name implies, will build every variety of steel car and will use wherever possible standard commercial shapes of rolled steel. An advantage thereby secured is that in case of damage to a car a railroad company can procure parts for repair without being dependent upon ability of the makers to supply duplicates. The whole steel producing industry of the United States is always available for this material.

The works at Canton, Ohio, have ample transportation facilities, being connected with the Wheeling & Lake Erie and the Pittsburgh, Ft. Wayne & Chicago railroads. The plant occupies about 40 acres of almost level land, and has, in addition, ordinary track facilities for the shops, about 10,000 ft. of storage and repair track. The machine and erecting shop is a building 508 ft. long by 80 ft. wide, built of single span steel framing with brick and hollow tile walls. Electric cranes run over the full length of this shop and outside for a distance of 150 ft. This arrangement provides means by which material unloaded from cars may be picked up at once and carried into the shop or placed temporarily out of the way.

Steel cars are built on trestles and when completed are lifted on to trucks, placed upon one of two tracks which run through the shop, and can then be drawn out for painting, brake tests, etc.

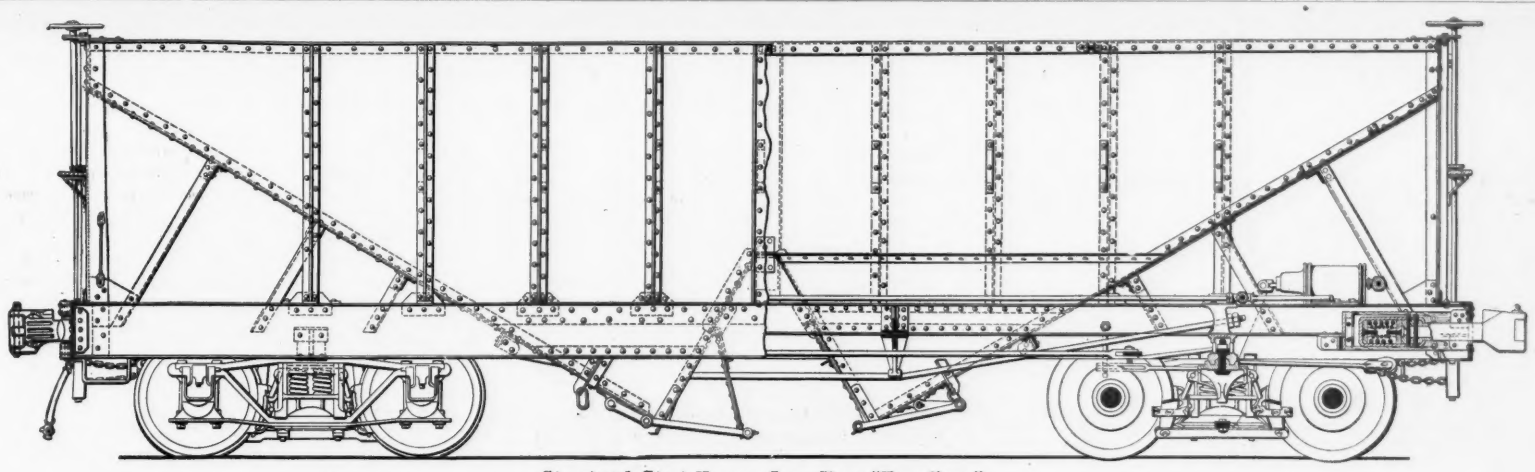
The principal equipment which the shop contains is, plate rolls, a multiple punch, 118 inches between the housings and having a capacity of 110 holes at each stroke. Two rapid action punches, a double ended punch, coping machines, bending machines, all made by the Cleveland Punch & Shear Co. Plates are cut on a Scully Rotary Shear. In the truck department there are a Watson & Stillman hydraulic press and a Grant axle lathe. All these machines are electrically driven by Westinghouse alternating-current motors.

The power house is 175 x 50 ft. and contains two Bass-Corliss engines of 500 h.-p., which drive the electric generators. Two 120 h.-p. air compressors supply air for the hammers, drills, reamers, etc., used in the erecting shop. The boiler room has a very complete installation of fire pumps, feed-water heaters, and two batteries of Bass vertical water-tube boilers. The forge shop is 75 x 50 ft. and contains two Acme forging machines, one Ajax bulldozer, one set of Ajax brake-lever rolls, one 1-000-lb. Bement & Miles drop hammer, an Acme bolt and rivet machine and a bolt threading machine by the same maker. The shop is also equipped with three furnaces in which gas or oil fuel may be used and four open-fire smith forges. The water supply for the whole shop is drawn from artesian wells. The store houses for oils, paints, and all material are most conveniently placed and the equipment of the plant compares favorably with any similar establishment in the country. The capacity of the plant is 50 cars a day and in view of enlargements in the future a shop of similar capacity has already been laid out and trackage provided for, besides the shop already completed.

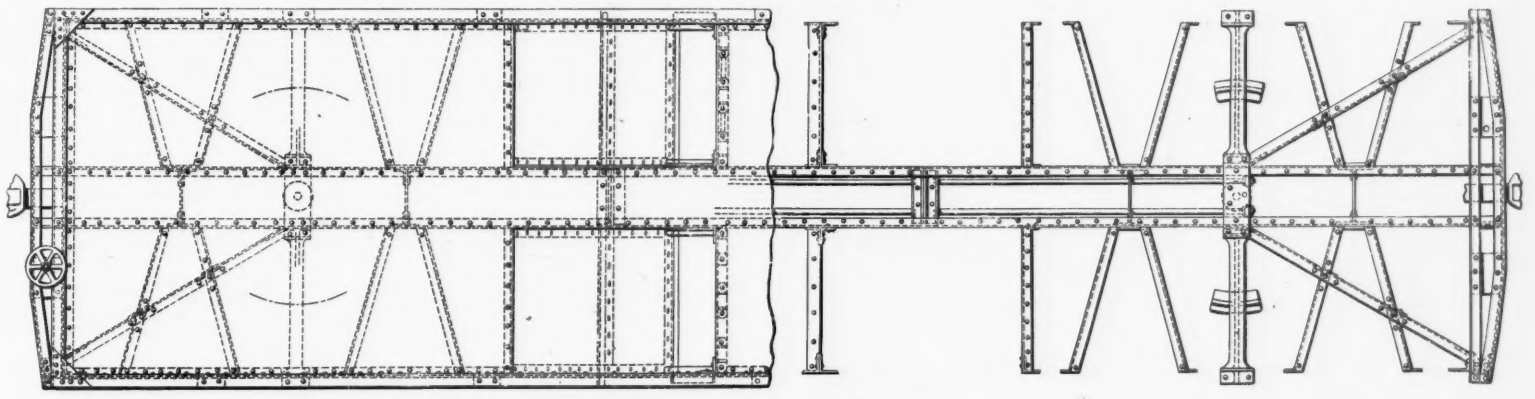
STRUCTURAL STEEL HIGH-SIDE HOPPER CAR.

This car illustrated has a capacity of 1,400 cu. ft., when filled level, and has a safe load of 132,000 lbs. The ratio of dead weight to revenue load is about 23.7 per cent. A very high ratio of paying load to gross load is possible in a steel car and in this case it amounts to the remarkable figure of 80.84 per cent. revenue load and 19.16 per cent. dead weight. The factor of safety is 6 and this is taken with 10 per cent. added to the load carried to compensate for vibratory strains not calculable. The car is 32 ft. 6 in. long; 9 ft. 3 in. wide, and stands 9 ft. 6 in. above the rail. The side sills are made of 15-in. channels, the side sheets are double riveted to the sills, and the plates are stiffened with tee bars. The center sills are 8-in. channels trussed. The truss rods do not terminate on the end sills, as is usual, but are anchored on the body bolsters, which have been modified to suit this form of construction. In order to relieve the body bolsters from the strain which would thus be put on them, cheek plates are riveted to the sills and are made to bear hard against the bolsters, so transferring all strain to the sills. The sloping floors of the hopper are supported on angle bars, and where the floor rises above the sills, angle steel struts are placed between floor and sills. The end sills are made of reverse angles and plates, the whole forming a truss. The corners are further stiffened by being braced with channels placed diagonally between them and the center sills, touching the latter at the point where center sills and body bolster connect. This form of bracing is effective in evenly distributing shocks or strains between outside and center sills.

The side bearings are cones, two in each bearing, running upon chilled steel wearing strips. The cones are made of chilled iron turning on 1½-in. bolts and encased in housings of cast steel. The truck bolster wearing strip is made long enough to give the cones full bearing, when the car is running on a curve of 180 ft. radius. The truck bolster is of new design, being open web and flange work. The object of this design is to obviate the danger of thin spots, which are often to be found where castings are of box section, and are made with the center cored out. The bolster ends are fitted with removable wearing strips where they rub on the arch bar separators. The doors of the hoppers are of the usual type for this



Structural Steel Hopper Car—Class "Vanadium."



Floor and Frame Plan—Hopper Gondola.

kind of car. Each door may be opened independently of the other, but both are operated from the side.

One desirable feature which this car has in common with others of steel construction is that the line of draw-bar thrust and pull comes where it can best be met—on the center line of the sills.

COVERED HOPPER CAR.

This company also builds a covered car with twin hoppers. It is intended for the carriage of dry marl, cement, lime in bulk, or any commodity which is likely to deteriorate if exposed to rain. Covers or doors for loading are therefore provided on top. The sides are of the plate girder type, like the hopper car described above. This car resembles the hopper car in a general way, but has no center or cross ridges and the center sills are not trussed, as the car is only designed to carry 80,000 lbs. The light weight of the car is 26,000 lbs., length 28 ft., and the height from rail to top of cover is 11 ft. 3 in. The internal capacity, with cover down, is 1,100 cu. ft. The angle selected for the sloping sides of hopper is 45 deg. The end bracing is of the clevis type, which will be referred to again.

THE HOPPER GONDOLA.

The capacity of the low-side hopper gondola built by the Structural Steel Co. is 1,600 cu. ft. It has a safe load of 160,000 lbs., while the light-weight is 32,000 lbs. The ratio of dead weight to paying load is 20 per cent. The sides are of the plate girder type, with stiffeners made of angle iron and placed diagonally on the outside of the car. The top and bottom edges are also stiffened with angle irons.

The end plates are secured by having the side plates continued down to meet the reverse angles and tee which secures the end plates to the sills. The center sills are trussed channels with diagonal corner braces.

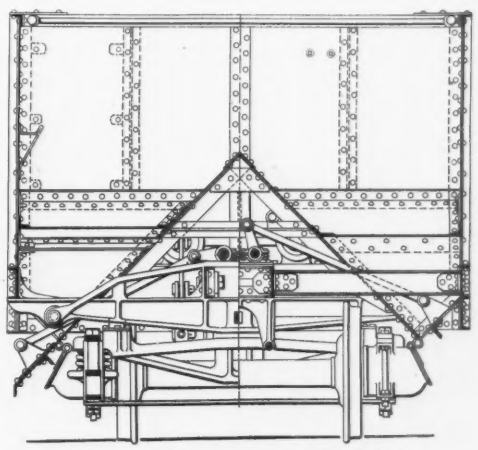
The center sills are tied together at short intervals with angles and vertical plates extending between them; every alternate tie has a flat plate on top of the center sills as well as the vertical angles and plates. This makes the two center sills virtually one box girder, and is a very strong form of construction. The floor supports are angles disposed at right angles to the sills, in certain places, and in V-shaped form in others. The hopper door frames are made of channels. In other respects the details of this car are like the hopper car, of which mention has already been made.

THE SIDE DUMPING CAR.

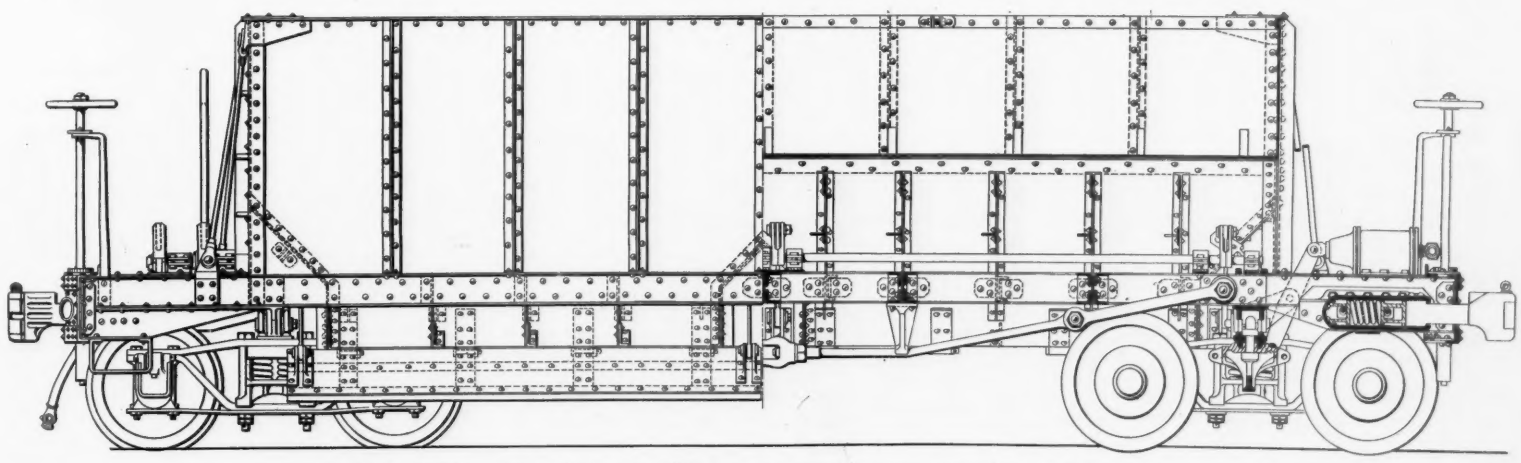
The side dumping car has the same cubic capacity as that of the hopper gondola, viz., 1,600 cu. ft.; it has the same light weight and also a capacity of 160,000 lbs. Of the gross load 83 per cent. is revenue load and 16 per cent. is dead weight. The plate girder construction is used on the sides like the hopper gondola, with the exception that tees and not angles are used as plate stiffeners. The standard center and side sills of the Structural Steel Car Co. are used under this car, also the side stakes and the end bracing. The center ridge is placed at an angle of 45 deg., and is carried on trusses of tee sections, the crown of the ridge being capped with a 6 x 6 in. angle. Pockets cover the dumping levers, which operate the four doors independently. All the doors are opened or closed by mechanism which is controlled from one end platform, while the brake gear occupies the other. The body bolsters are trussed with rods over the center sills in such a way as to form a sort of "camel back" truss. The ends of the cars are braced with what may be called clevis bars. These are diagonal braces, with clevis and screw thread on each end, which can be drawn to the required tension and this method of bracing prevents the "end swing" which has a tendency to break off corner posts and work the rivets loose at the ends of the side sheets.

STEEL FLAT CAR.

This steel flat car is 40 ft. long by 9 ft. 3 in. wide, and has a safe load of 160,000 lbs. The light weight of this car is 27,000 lbs., while the weight of the average car is 27,000 lbs. and that the weight of the average 100,000 lbs. flat car is 34,000 lbs. In other words, usually a flat car weighing 17 tons will carry 50, but the steel flat car referred to, weighing 13½ tons, will carry 80. The flat car has the manufacturer's standard center sills, while the side sills are made very stiff and strong. The side sill is composed of a plate to which a 12-in. channel is riveted flush with the upper edge. The portion of the plate below the channel is stiffened by an angle and the sill has its greatest depth at the center of the car. The choice of wood or steel for decking is left to the discretion of the purchasers, though a form of rolled steel of raised diamond pattern known as "Never Slip," is mentioned by the Structural Steel Company as a very satisfactory covering.



Side Dumping Structural Steel Car.



Side Dumping Coal and Ore Cars, 160 Pounds Capacity—Structural Steel Car Company.

The First Fifty Years of the American Society of Civil Engineers—1852-1902.*

BY CHARLES WARREN HUNT, *Secretary, Am. Soc. C. E.*

I have been requested by the Board of Direction to present to this meeting a brief summary of the history of the Society during the first 50 years of its existence, which period will be completed before the next general meeting. Perhaps the best way of introducing the subject will be to read the minutes of the first meeting of the Society, as follows:

"On the evening of the 5th of November, 1852, a number of Civil Engineers and Architects convened at the office of the Croton Aqueduct Department, in the City of New York, agreeably to a circular issued on the 23d day of October by several members of the professions to their professional brethren in this city and vicinity, the following gentlemen being present: Julius W. Adams, New York; James Laurie, New York; Thomas A. Emmet, New York; J. W. Ayres, New York; Edward Gardiner, New York; W. H. Talcott, New Jersey; Robert B. Gorsuch, New York; W. H. Morrell, New York; W. H. Sidell, New York; S. S. Post, Owego, Tioga Co., N. Y.; Alfred W. Craven, New York; G. S. Greene, Albany.

"The meeting was called to order by A. W. Craven, on whose motion Maj. W. H. Morrell was elected to the chair, when, upon the motion of James Laurie, T. A. Emmet and R. B. Borsuch were appointed Secretaries.

"James Laurie then moved that a committee to report a constitution and by-laws be appointed by the chair, which was adopted; and James Laurie, Julius W. Adams and W. H. Sidell were appointed.

"The Committee retired for consultation, and after a short absence reported a draft of a constitution and by-laws, also a copy of the general law of the State of New York authorizing the incorporation of scientific societies, which were severally read to the meeting by J. W. Adams.

"The Constitution was then taken up by sections, discussed, amended and adopted.

"James Laurie presented the following resolution:

"Resolved, That the American Society of Civil Engineers and Architects be incorporated under the act of 1848, Chap. 319 of Laws of New York, which was adopted. It was also

"Resolved, That the members of this Society shall be those who being by the Constitution eligible, sign the Constitution at the time of its adoption, and those who may be invited by the Board of Direction to attend the first regular meeting, to be held on the first Wednesday in December next, and shall attend or signify their intention to become members on or before that date, and shall pay to the Treasurer their entrance fee and first annual contribution, and all those who shall thereafter become members in conformity with the Constitution.

"A. W. Craven then moved that a committee be appointed to nominate officers, which was adopted.

"S. S. Post moved that the committee be a committee of the whole, whereupon James Laurie offered an amendment that the committee consist of three. The question was first taken on Mr. Laurie's amendment, which was lost; then on Mr. Post's motion, which was carried.

"The meeting then resolved itself into a committee of the whole to nominate officers. The Committee presented the following nominations:

"For President, James Laurie.

"For Vice-Presidents, Edward Gardiner, C. W. Copeland.

"For Directors, W. H. Morrell, W. H. Sidell, J. W. Adams, J. P. Kirkwood, A. W. Craven.

"For Secretary and Treasurer, Robert B. Gorsuch.

"The meeting then proceeded to ballot, when the above named officers were unanimously elected.

"James Laurie presented the following resolution:

"Resolved, That the Board of Direction be authorized to issue a circular asking the aid and co-operation of those eligible as members in sustaining this Society, and to have the Constitution, By-laws and Act of Incorporation printed for the use of the members, which was adopted.

"A vote of thanks was then tendered to the Chairman and Secretaries, and the meeting then adjourned until the first Wednesday in December.

"R. B. GORSUCH, Secretary."

"JAMES LAURIE, President."

The only one, of those who attended this meeting and thus became the founders of the Society, known to be alive, is Robert B. Gorsuch, its first Secretary and Treasurer, who is still in the active practice of the profession in the City of Mexico.

The objects of the Society, as incorporated in the Constitution which was adopted at that meeting, and issued in a circular to engineers five days later, were:

"The professional improvement of its members, the encouragement of social intercourse among men of practical science, the advancement of engineering in its several branches, and of architecture, and the establishment of a central point of reference and union for its members." And —this circular continues—"Among the means to be employed for attaining these ends shall be periodical meetings for the reading of professional papers, and the discussion of scientific subjects, the foundation of a library, the collection of maps, drawings and models, and the publication of such parts of the proceedings as may be deemed expedient."

Eight meetings were held during 1853, at which the average attendance was six, and only fourteen individuals, all told, came to these meetings. At the end of the first year, the total membership was 48, the total receipts 700, and the total expenditures $115.22. In 1854 but six meetings were held, at which the average attendance was less than that of the previous year. The total receipts of that year also decreased to $150, and expenditures to $32.02.

It may be of interest to note that the first subject for professional discussion was "The Relief of Broadway," and that Mr. James Laurie, President, at the meeting of Jan. 5, 1853, described a plan for placing railroad tracks above the level of the street, the subject being discussed by the members present. . . .

The first formal paper was presented to the Society on March 2, 1855. It was by William H. Talcott, and was entitled "Results of Some Experiments on the Strength of Cast Iron."

It appears that at this early stage the founders of the Society had great difficulty in interesting in it engineers who lived at a distance, and early in January, 1855, one of its most active promoters, Mr. James O. Morse, who a month previous had been elected Secretary and Treasurer, tendered his resignation of the former office to take effect as soon as his successor was appointed. In 1867, inasmuch as no such appointment had been made (and for more than twelve years no meetings of the Society held), Mr. Morse was still the Secretary, and became active in the reorganization. He served continuously as Treasurer of the Society for 21 years.

On Oct. 2, 1867, pursuant to the call of Mr. James Laurie, President, a special meeting of the Society was held at the office of C. W. Copeland, 171 Broadway, five of those who were present at the first meeting in 1852, and five others, being present. The minutes of the last meeting of the Society were read and approved, and steps were taken to revive interest in the organization. It was determined to establish a headquarters as soon as possible, and this was accomplished in less than a month.

The Annual Meeting of Nov. 6, 1867, in the Chamber of Commerce Building, 63 William street, was the first held in rooms devoted exclusively to the purposes of the Society. . . .

Continuously since this reorganization, semi-monthly meetings, except during the summer, have been held on the first and third Wednesdays of each month.

The first publication was the address of President James P. Kirkwood, delivered Dec. 4, 1867, but not printed until somewhat later. It constitutes the first pages of Volume I of *Transactions*, which bears the date of 1872. In that address, Mr. Kirkwood points out that the original failure of the Society to interest non-resident members was due to the fact that no place was established to which members "could point as evidence of our being something more than a parchment Society," and that in order to maintain a bond between all classes of members it was necessary that papers should be printed and disseminated to those who could not be present at the meetings.

In March, 1868, the name of the Society was changed to that which it now bears. It was not until 1877, however, that the failure of the officers to carry out the instructions given in 1852 for the incorporation of the Society was discovered, so that, the proper steps being taken, the original incorporation of the Society was under its present name. . . .

At the end of 1869 the total membership was 160, and since that time the average net yearly increase has been as follows:

For the ten years, 1870 to 1879	44.1
For the ten years, 1880 to 1889	69.5
For the ten years, 1890 to 1899	90.3
For the two years, 1900 to 1901	164.5

The total membership to-day is 2,603. . . .

It is interesting to note that while minor donations for special purposes have been received by the Society, its growth and prosperity have been entirely dependent on its own resources. It has no endowment, and has always been supported by the dues paid by its members.

In 1896 the system of publications was entirely changed, the object being to issue in a regular monthly publication all professional papers in advance of the date set for their discussion, in order to allow to every member opportunity to give his views on any subject presented. The gratifying results of this change have been given recently in detail in the annual reports.

Since the occupation of the new house, the Library, which now contains more than 40,000 volumes, has been rearranged, classified and thoroughly indexed, and two years ago a complete catalogue was issued. The addition of more than 6,000 volumes during 1901 indicates clearly the rapidity of the growth of such a library when systematic efforts are made to complete its files and bring it up to date. . . .

That the influence of the Society is far-reaching is shown by the fact that it has members in 51 of the 54 subdivisions of this Republic, as well as in 31 foreign countries. This foreign membership constitutes 9½ per cent. of the total list. . . .

*Brief historical notes prepared for presentation to the Annual Convention of the American Society of Civil Engineers, held in Washington, D. C., May 20, 1902.

The Page Dump Car.

In January, 1895, we published a description of a dump car patented by C. D. Page, which had six boxes mounted on one frame, three tipping to one side and three to the other. The accompanying photographs and drawings show a new and later design of car, four of which, somewhat modified for narrow gage, have been in coal and ballast service for two years and a half on the White Pass & Yukon Railroad. The car shown is one recently built by the Laconia Car Co. It has been in service since April 1st on maintenance of way on the Boston & Maine, and has proved well adapted to that class of work.

Fig. 1.—General View of Page Car, One Box Tipped.

Fig. 2.—Loading Page Car by Hand.

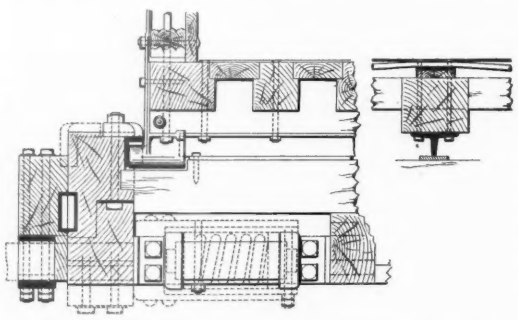


Fig. 3.—Section Showing Mounting of Box Body and Attachment of Draft Gear—Page Car.

The car consists of a heavy wood under frame with rigidly supported upright frames in the center and at both ends. Between these uprights and resting on the center sill of the car frame are mounted two tip boxes built of structural steel which are held in any position and dumped to either side by reversible pawl clutch jacks secured to the frame which grip the jack bands bolted to the ends of the boxes. Fig. 3 shows the bearing of the boxes on the center sill and the method of cutting away the sill to form a draft spring pocket. A 5-in. T iron is bolted to the subsill of the box floor and rocks on the edge of the web on a ⅜ in. by 3 in. plate secured to the top of the center sill. Trunnions at both ends are riveted to the T iron and turn in hoods fastened in the upright frames. These keep the boxes in a central position but carry none of the weight. The side doors are hung from the end frames on friction rollers and are independent of the boxes. On the bottom edge are fingers engaging lugs on the channels forming the side sills of the boxes, which take the side thrust of the load and on the top edge is a truss rod to prevent outward buckling. These doors may be swung up on top the uprights when loading by hand, as shown in Fig. 2.

The framing of the car is rigidly designed, all the longitudinal sills being tied together by spacer blocks and tie rods. Malleable iron pockets are used in joining the upright frames. M. C. B. standards have been maintained throughout.

The claims made for this car are simplicity and strength of design, the dumping jacks which are readily removable being the only mechanism about the car; durability, the boxes constructed and lined with steel; adaptability, while designed especially for ballast, capable of handling coal, ore, stone or any other material handled in bulk; and facility of operation, one man being capable of dumping the entire load. The car when loaded with 87,000 lbs. of gravel was dumped by one man in five minutes. When loaded with 46,000 lbs. of coal, the car was stopped, the entire contents dumped, the boxes replaced in position and the car moved off in eight minutes, one man doing all the work. Fig. 1 shows a general view of the car with one box tipped. The general dimensions are:

Weight in working order	38,700 lbs.
Length over all	34 ft.
Height from rail to top of sheathing	9 ft. 2 in.
Inside length of box	15 ft.
Inside width of box	8 ft. 9½ in.
Height of box doors	2 ft. 6 in.
Cubic capacity	15 cu. yds. per box
Capacity	80,000 lbs.

The American Brake Shoe & Foundry Company's Plant at Mahwah, N. J.

We gave, in the *Railroad Gazette* of Feb. 7, p. 99, and April 4, p. 254, short notices of the incorporation of the American Brake Shoe & Foundry Co. and some reference to its capital stock and the interests that were merged in the consolidation which this company represents. In connection with the description of one of its important foundry plants, we now give a further review of the interests represented.

This company will practically control the brake shoe output of the country and its make-up includes the Ramapo Foundry Co., of Mahwah, N. J.; the Sargent Company, of Chicago, Ill.; the Lappin Brake Shoe Co., of Bloomfield, N. J.; the Corning Brake Shoe Co., Corning, N. Y., and the Streeter Brake Shoe Co. and the American Brake Shoe Co., both of Chicago, Ill.

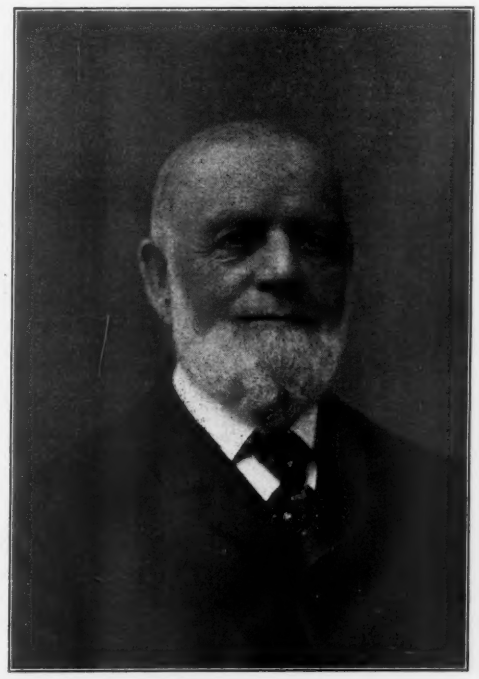
The combined output of the foundries is about 60,000 tons of brake shoes and iron and steel castings yearly, representing from $2,500,000 to $3,000,000 in value. The capital stock has been increased to $4,500,000, although the company was originally capitalized at $125,000. Three millions is 7 per cent. preferred stock and $1,500,000 is common stock at par value of $100. Bonds amounting to $1,000,000 have been issued. The well-known brake shoes, the manufacture of which is represented by this company, are the Sargent skeleton steel shoe, the "Diamond S," the Skeleton steel insert, the Lappin steel back, the Streeter steel back, the Corning and the Ross-Meehan.

Mr. W. W. Snow is Chairman of the Board of Directors and Mr. W. D. Sargent is President. The names of other officers were given in our issue of Feb. 7. The offices are now at 170 Broadway, New York.

The Mahwah plant (formerly the plant of the Ramapo Foundry Co.) is about one mile southeast of Suffern, N. Y., on the main line of the Erie Railroad. The plant, as shown in the general layout given herewith, is well supplied with private tracks and has a 25-ton switching locomotive of its own. The Mahwah Creek gives a good independent water supply for the works, and the site, about 40 acres in all, is well located for convenient shipment to and from the works.

These works at present have a daily capacity of about 3,000 brake shoes and are also turning out large quantities of castings for telegraph, telephone and subway work for street railways in New York and elsewhere. Other miscellaneous castings are made, including high-grade machinery castings, in considerable variety. The daily output of the works is now from 65 to 70 tons of metal. This is the seventh foundry built by Mr. W. W. Snow, and it has been running about one year.

By referring to the general layout it will be seen that the plant is divided into four main departments, namely, the foundry, machine and pattern shop, power house and pattern storehouse. The power house is 35 x 75 ft., of brick, one story, with steel roof. In it there are two Stirling water-tube boilers of 150 h.p. each, hand-fired with buckwheat coal; a Worthington jet condenser, a Worthington feed pump for supplying 300 boiler horse power, and a Westinghouse enclosed engine of 100 h.p., direct-connected to a generator having a capacity of 250 amperes at 250 volts. Provision has been made for the immediate installation of a De Laval steam turbine of 225 h.p., made by the De Laval Steam Turbine Co., of Trenton, N. J., to which will be directly connected a 150 k.w. Milwaukee generator, direct current 250 volts. These generators will furnish current for the foundry cranes and blowers, for the machine and pattern shop motors, and for other individual motor drives which are interesting features of the plant. There is a Franklin duplex air compressor with a capacity of 408 cubic feet of free air per minute, the working steam pressure being 125 lbs. and the air pressure 100 lbs. An independent Worthington fire pump with a capacity of 1,000 gals. per minute supplies hydrants liberally placed about the works. An adequate reservoir will at once be installed on a neighboring hill to supply a constant pressure in the fire system water mains, and a complete system of automatic sprinklers will be put in the buildings. The head will be enough to give moderate pressure at the hydrants until the fire pump is brought into action when needed.



W. W. Snow, Chairman of the Board of Directors, American Brake Shoe & Foundry Co.

The machine shop is 50 x 110 ft. and is of two stories, with the pattern shop on the second floor. These shops are equipped with the necessary lathes, planers, woodworking machinery and other machine tools to do the new and repair work of the plant.

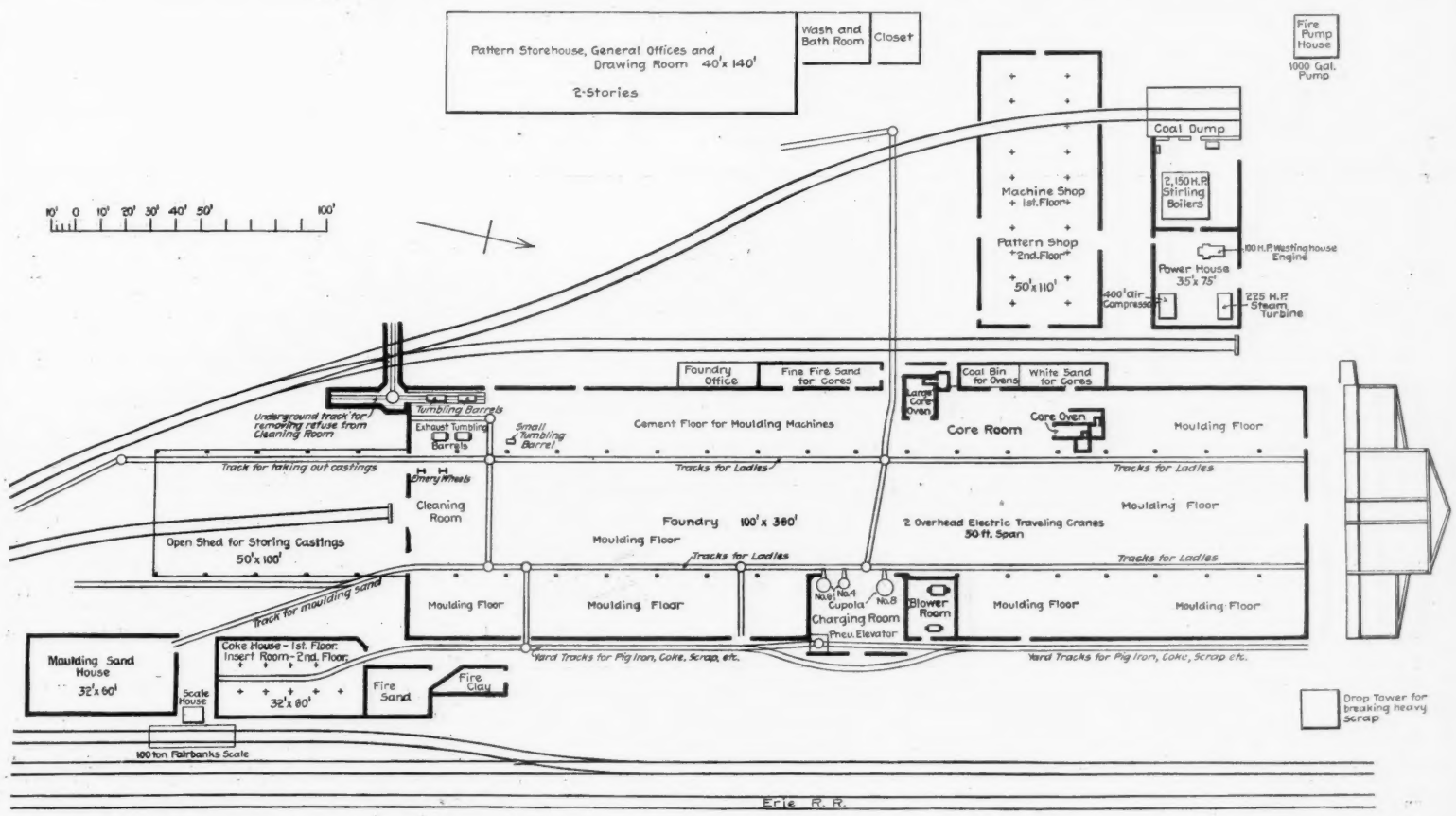
The foundry building is largely of brick and glass, 100 x 360 ft., and at the south end of it there is a shipping shed 50 x 100 ft. The foundry building has a clear-story 9 ft. high over the two electric cranes, which traverse the full length of the foundry and the shipping shed. These cranes were made by the Morgan Engineering Co., one being of 10 tons and the other of five tons capacity. There will presently be another crane of 20 tons capacity put in.

There are three Whiting cupolas, styles No. 4, No. 6 and No. 8, the combined maximum capacity of which is 140 tons daily. Blast for the cupolas is furnished by three Root motor-driven blowers and the fuel is coke. There are three large core ovens of the most improved design and five molding machines which are used on brake-shoe, subway and other light castings. One side of the foundry has concrete floor, to facilitate movement of the molding machines, all of which are operated by compressed air.

The drop for breaking large castings weighs about 1,800 lbs. and is lifted by an electric motor attached to the cable reel. A pneumatic elevator serves the charging room of the cupolas, charging-cars with a capacity of one charge each being weighed at the track-level before hoisting. The charging room holds 15 cars, the contents of which are used at discretion. Ample coke and sand sheds are provided.

The office building contains, besides the offices and a fireproof vault for records, a pattern storage room, a storeroom for supplies, and the draughting room. The building is 40 x 140 ft. and is built on concrete piles from 14 to 20 ft. high. There are in all 34 piles, 6 ft. square at the base and 2 ft. 6 in. square at the top. By going down from 4 to 6 ft. in the swampy ground, hard gravel bottom was found and the space under the office building is now being filled around the concrete piles with cinder. On the north end of this building are the washroom, bathroom, closets and suitable lockers for the use of the 300 employees. There is also one other detached building, the coke house, which is of two stories, the lower story being used for coke and the upper part for cutting expanded sheet steel in proper shapes for use in the "Diamond S" brake shoe, and to store steel inserts for the Ross-Meehan shoe. The shears in this department are driven by belted electric motors.

This plant, as a whole, is very attractive in its appointments, and its location is admirable. It bears evidence of the thoroughness that has marked all of the work of Mr. W. W. Snow and it is fitted to bear an important part in the work of the American Brake Shoe & Foundry Co.



The American Brake Shoe & Foundry Company's Plant at Mahwah, New Jersey.

Chicago Track Elevation.

The mandatory ordinance passed by the Chicago City Council reported in our issue of April 11 has been accepted by the Chicago & North Western, word having been sent to the municipal authorities that it was ready to begin the elevation of its tracks from Canal street to Central avenue, which is very near the western city limits. At the time of the passage of the ordinance it was mentioned that its acceptance by the railroads would involve the construction of two very expensive subways, one each at Robey and Leavitt streets, and that the roads were objecting to an acceptance on this account. The

city has agreed to the omission of the Leavitt street subway, and a new ordinance is to be framed extending the required elevation eastward to Canal street, involving the building of six additional subways. The work will extend west to Western avenue, the estimated cost for all roads concerned being $3,000,000. The Burlington, North-Western & Chicago Terminal Transfer will all accept the ordinance affecting their tracks south of Fourteenth street. This elevation will do away with the Halsted street viaduct, which will be replaced with a subway. The dispute over elevation at Grand crossing is to be settled by a new ordinance omitting the requirement for a subway at Seventy-ninth street. The Lake Shore, Illinois Central and Pennsylvania are concerned in this work.

The Microscope and the Metallurgy of Steel.

It is not the intention of this article to explore all the details in connection with the practical application of the art of microscopy to the study of the physical construction of steel. A brief review in a general way will be given on the microscopy of cast steel as the result of a study and a long series of experiments conducted by the Leighton & Howard Steel Company, formerly the Shickle, Harrison & Howard Company, of St. Louis.

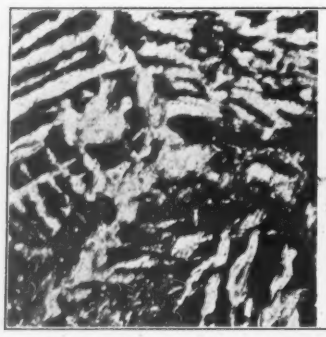


Fig. 1.—Unannealed Steel.

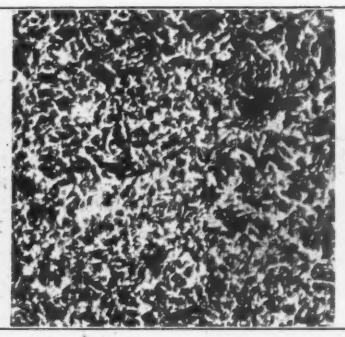


Fig. 2.—Properly Annealed Steel.

Fig. 3.—Over Annealed Steel.

Note: *Figs.* 1, 2 *and* 3, *magnified* 140 *diameters.*

Cast steel, by its great strength, its marvelous ductility, its shock-resisting qualities and its adaptability to many purposes where such qualities are necessary, is a material worthy of the admiration of engineers. The study to improve upon the manufacture of and the qualities of cast steel offers an inviting field for research and investigation. When cast-steel is used it is but fair to both manufacturer and purchaser that it should meet the expectation of all concerned. To make cast-steel that is a credit to the manufacturer and satisfactory to the consumer is an art that is making rapid progress. It has been evident to engineers and metallurgists for some years that to explain some of the physical properties of cast steel, a knowledge beyond that gained by a mere chemical analysis was needed. It was when this point was fully realized that the microscope came to the rescue.

By its aid the discovery was made that only by a certain crystalline arrangement was steel, of a known chemical analysis, and for a specific purpose, in the best possible physical condition to perform successfully the service demanded. Chemistry cannot explain the different degrees of crystallization. By chemical analysis we learn the ultimate composition. By the microscope can be acquired, in a great measure, information regarding the structure of steel.

Of great importance in fixing the proper crystalline structure is an intelligent knowledge of heat treatment and thermal conditions throughout. The accompanying engravings from photographs made through a microscope, show plainly the changes in the structure of cast steel as the result of annealing. The photographs were made from specimens from the same piece of steel, subjected to different temperatures. Fig. 1 shows the usual structure of normal steel as cast. The light parts are known as "ferrite" or carbonless iron. The dark parts are known as "pearlite," an alloy of iron and carbon. Steel with this structure is brittle, stands a poor bending test and does not give good results in ductility; nor does it well resist shocks or torsional and transverse strains.

Fig. 2 shows a structure produced by judicious heat-treatment, or annealing. The ultimate composition and the proportion of pearlite and ferrite are the same. The difference is in the diffusion of the two constituents, the photograph showing a fine micro-grain and a complete obliteration of the coarse crystals. Such steel is capable of resisting all strains without manifesting brittleness. It has great ductility and can be bent flat upon itself without fracture.

Fig. 3 shows a structure formed by imperfect or overheating. It will be seen there is a tendency toward a growth of a larger micro-grain, along with an enlargement of the crystals of the mass. Such steel is less brittle than the first specimen and falls short of the ductility and toughness of the second.

Fig. 4 presents a more extensive exhibit of results from a series of these experiments and shows clearly the effect of heat on the physical properties of the steel. All of these specimens were from one piece of steel, having 0.39 per cent. of carbon. The treatment was applied in an electrical furnace and the temperature taken with a Le Chatelier pyrometer. The pieces were cooled slowly and bent when cold. Fig. 5 shows a specimen of properly annealed steel before and after subjection to a tensile test. The tensile strength developed was 69,600 lbs., with an elongation of 32 per cent. and a reduction in area of 42.18 per cent.

To one trained in metallography a glance is sufficient to determine by the microscope the heat treatment to which a given piece of cast-steel has been subjected. The size, shape and arrangement of its crystals and microstructure are all controlled in a finished casting by heating and cooling slowly or quickly. The physical properties of the metal are as closely allied to the structure as the structure is to the heat-treatment. To produce desirable results in cast-steel it is necessary to know what thermal conditions to observe in order to throw all possible safeguards around the product. This knowledge can only be gained by scientific pyrometry and comparative study of microstructures as affected by heat treatment, together with the known chemical composition.

Steel Cooled from Casting Temperature Bent 90°
Heated to 600° Bent 88
Heated to 650° Bent 67.5
Heated to 700° Bent 106.5
Heated to 750° Bent 90
Heated to 780° Bent 143.5
Heated to 800° Bent 193
Heated to 900° Bent 98
Heated to 1000° Bent 74
Heated to 1130° Bent 130

Fig. 4.—Results of Heat Treatment of Cast Steel.

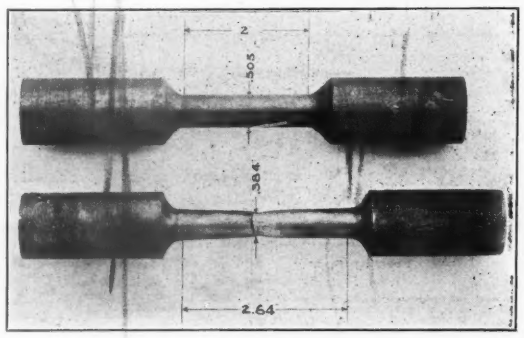


Fig. 5.— Properly Annealed Steel—Tensile Test.

It is the aim of the metallurgist to apply to industrial problems deductions gained by investigation and research conducted in the laboratory. The laws producing certain effects are observed by experiment, then with the needful instruments the practical operation of annealing castings is much simplified, and all notions so diversified on that question can be lifted out of guesswork to the plane of definite information. With a pyrometer of reliable accuracy, and the microscopical tests to verify the temperature compared with established standards prepared in the laboratory, the industrial operation of annealing becomes a laboratory practice.

A study of the various structures with known thermal conditions impresses one with their striking beauty and the immense value of the information derived therefrom. With a known chemical composition and a known history of heat treatment, it is possible to predict with an element of success the physical qualities of steel castings when examined with a microscope; hence its value to the metallurgist or engineer is of such importance that it becomes indispensable. C. H.

The Course in Car Design at Purdue University.

BY WILLIAM FORSYTH.

Associate Professor of Car and Locomotive Design.

The following is a description of the course in car design as conducted during the fall term of 1901 at Purdue University. It occupied fourteen weeks, two afternoons each week in the drafting room. The general outline of the course was based on the various details of the car, commencing with the wheels and axles and proceeding regularly upward through the truck to the body, frame and roof. The principal items being: car wheels, axles, journal bearing, journal boxes, truck side frame, bolster springs and center plates, and general plan of the truck. Then taking up the car body, it was treated in a similar manner in the following order: body bolster, draft gear, the air-brake, brake-shoes, brake levers longitudinal sills and trusses of the under frame, side trusses of the upper frame and the roof.

The work in the drawing room was introduced by a brief lecture explaining the principles involved in the work at hand, and giving necessary data, and some historical account of the development of the subject under consideration.

It was found that a constant reference to the Master Car Builders' Standards and to the reports in their Proceedings was of great value. The pamphlet containing the M. C. B. Standards and Recommended Practice, together with the drawings of standards was obtained by the class, and proved to be the most useful text-book that could have been selected. By its use the students were made familiar, not only with the design of car details, but they were informed as to those which had proved to have such excellence as to be generally adopted as standards, and which represent the latest and best practice of car building in this country.

Taking the wheel and axle as examples, the full-sized sections for 60,000, 80,000 and 100,000-lb. wheels were drawn in accordance with the recommendation of the last M. C. B. Committee on the subject. The differences in these sections were explained, and it was shown that on account of the limited guard rail and frog wing space, it was difficult to increase the strength of the flange in proportion to the increased loads and stresses which it is compelled to resist. From an examination of these drawings, it was found that the thickness of hubs and brackets the tread and flange remained the same and the thickness of plate was increased from ⅝ of an inch for 60,000 to ¾ of an inch for 100,000 lb.

The relation of the radius of the throat of flange to that of the rail head was next considered, and the conclusions of the report of the American Society of Civil Engineers were given on this subject in detail. The specifications for the drop test and the thermal test of car wheels were explained.

Next, taking up the freight car axle, it was shown how the shape of those for 20 and 30-ton cars was developed from a straight shaft by gradually increasing the size at points where failure most frequently occurred, and that the 40-ton axle was the first one which was made the subject of an analytic investigation. An 80,000-lb. axle was designed by the use of Ruleaux's Graphic Method.

The relation of the wheel and axle to the rail was then explained and standard gage points for center of journal, distance between flanges and the gage of track were marked on the drawings.

The truck side was treated by the design of a set of arch bars for an 80,000-lb. car, and the consideration of the vertical loads reveal the fact that they must constitute but a very small proportion of the total loads which they are called upon to resist if we measure this by the area of the section in present existing designs. The experiments made by the chairman of the committee on the 80,000-lb. axle, on a freight car on the Philadelphia & Erie road, with truck springs arranged with a gage apparatus to indicate the total deflection, is the only one on American cars to which reference could be made to show that the live load on journals increases the stress due to static load nearly 100 per cent. For stress in arch bars due to horizontal forces no exact measurements have been made by experiments on American cars.

Several designs were made for pressed steel truck sides in which the proportions used were the same as those in general use, but the stresses at different points under assumed loads were figured. The practice throughout the course was to use for the truck and the body bolster loads equal to double static loads and for all above body bolster, one and one-half times the static load. Assuming such loads for 80,000 and 100,000-lb. cars, it is found that the stresses in some of the existing designs in general use were very high.

For the lessons in bolster springs, the helical springs for cars of different capacity, as recommended by the M. C. B. committee, were drawn by different members of the class, and their strength and deflection calculated by the usual formulæ. The work of Mr. John Cloud and Mr. George Henderson in making clear the application

of these formulæ was referred to, and some of the data as to the strength of spring steel as given in their papers and the results of the test made at Watertown Arsenal for the Pennsylvania Railroad on tempered and untempered steel were used.

On the subject of truck bolsters, there was fine opportunity for calculations of the strength and deflection of beams of various sections with center load and with distributed load, and for beams of various material; cast steel, rolled steel, those made of I-beams, those made of plate, those composed of plates and truss rods.

The car bolster had been made the subject of theses by students in previous years and their work involved the testing of the strength of deflection of the principal truck body bolsters now on the market. The deflection under various loads was plotted in the diagrams and the elastic limit of the structure was shown graphically. As in the case of truck sides, it was found that in some designs of bolsters in common use, the stress was very high and deflection excessive.

After the bolsters came an explanation of the various forms of center plates and side bearings in which the value of lubrication and anti-friction devices was discussed. Some improved designs were explained by sketches, and the figures relating to the tests of center-plate and side-bearing friction were given. The proper width for the center plate to insure stability of car body was determined by a graphic analysis of the horizontal forces acting at center of gravity of car tending to tip it.

Having thus drawn the various details of a truck and calculated their proportions or stresses, the general plan of the freight trucks was next taken up. Some designs included arch bars and cast-steel bolsters; others used the I-beams of the Bettendorf type, and others were composed entirely of pressed steel.

Having completed the work on the truck the car body was next considered and the first important details found attached to the under frame, the air-brakes and the draft gear, were taken up. The development of the Westinghouse air-brake was described with some account of the Galton-Westinghouse experiments in England which led up to the design of the automatic and high speed, and an account of the Burlington brake test, which resulted in the design of the quick acting freight brake. The action of truck levers on the brake-beam was explained and illustrated by examples, and the Hodge and Stevens systems of body-brake levers were also illustrated by problems in finding the lengths of the two arms of the cylinder lever for cars of different weights. While no drawings of brake-shoes were made, there was good opportunity to refer to the experiments on brake-shoe friction, which had been made at the University laboratory under the directions of Professor Smart on the M. C. B. brake-shoe testing machine, which is in the laboratory of the University. It is frequently employed in testing various kinds of brake-shoes, and this affords admirable opportunity to get exact information in a short time in regard to the coefficient of friction of brake-shoe material, in contrast with the slow and uncertain methods used heretofore in service test.

The constant resistance of the car wheel on the rail at various speeds was explained, and the varying resistance of the brake-shoe on the wheel at different speeds was indicated by the diagrams obtained on the brake-shoe testing machine, which also illustrated plainly the great difference in brake-shoe friction obtained from different materials.

The requirements of the Interstate Commerce Law in regard to automatic couplers and air-brakes were explained. The M. C. B. draft gear with single spring was drawn by a few of the class, and others made plans of improved draft attachments. The effect of two springs used tandem and side by side was explained, and also the value of separate stops for each spring. The resistance of the improved friction draft gears was shown by diagrams on the board. The work done in compressing springs was calculated, and this, compared with that absorbed by the friction devices, as calculated from the diagram. Finally all these resistances were compared with the stored energy in the moving car at slow speed. It was shown that the best friction gears would absorb from eight to ten times as much as the M. C. B. spring.

The class was fortunate this year in having at the testing laboratory for strength of materials an interesting collection of some 37 samples of improved draft gears (21 of them from six different companies, being friction devices) sent to Purdue for test under the direction of the M. C. B. Committee on Draft Gear. Two members of the class have made friction draft gear and draft attachments the subject of their theses, and they have taken an active part in the work of testing the draft gear samples.

The longitudinal sills and truss rods on wooden car under frame were drawn, and the strength of the sills and their proper sections was calculated.

The stresses in steel car frames were figured for three different forms of side sills: First, those made of rolled section and truss rods; second, those made of pressed steel channels with deep section at the center; third, those made of plate girders.

The weights of wooden cars and steel cars of various capacity were tabulated with a column showing the ratios of paying freight to total weight and the gain in this respect which is generally supposed to have been rather important by the use of steel cars, was shown to be not very large. In the 30-ton wooden box car this ratio was found to be about 70, while in the 50-ton box car with steel under frames it is only increased to 73. There seems to be a very close ratio of about 70 for similar comparisons of wood or steel gondola and hopper cars of various capacities. A complete upper framing for the new standard 36 ft. box car was drawn, to illustrate the wood construction in the sides, ends and roof of the box cars.

The advantages which exist at Purdue for such a course in Car Design are unusual, on account of the valuable apparatus there and the actual tests of car details on a large scale, which are constantly being carried out at this place. The equipment for testing the triple valves on 50 cars which belong to the M. C. B. Association, and which is deposited here is available for use by the students in making themselves familiar with the air-brake apparatus. The M. C. B. brake-shoe testing machine occupies a prominent place in the laboratory, and is employed in commercial work with the assistance of some of the senior class. The large collection of improved draft gears which filled up the laboratory during most of the spring, brought the students in close contact with the progress which is being made in this direction.

There is also in the laboratory a good collection of full sized modern freight trucks, truck bolsters, body bolsters and brake beams. The bolsters and brake beams have been tested and the diagrams illustrating the loads and deflections are available for the use of the students in Car Design.

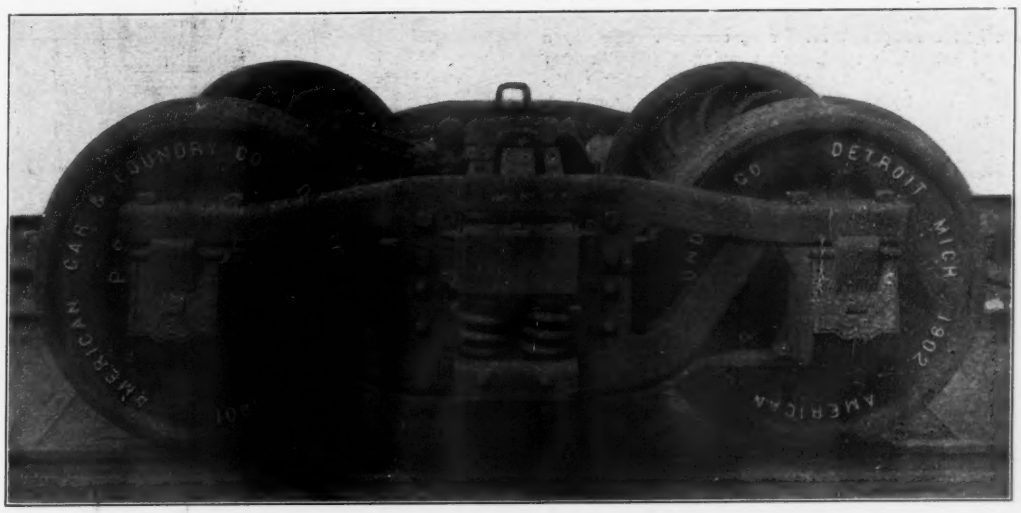
Considering the short period available for the work in this course and the fact that it was in a measure the first attempt at a distinct administration of this subject, it is believed that it is a practical and useful course which can be further developed each year and thus made of particular value to the railroads, and eventually show its influence in the M. C. B. Association.

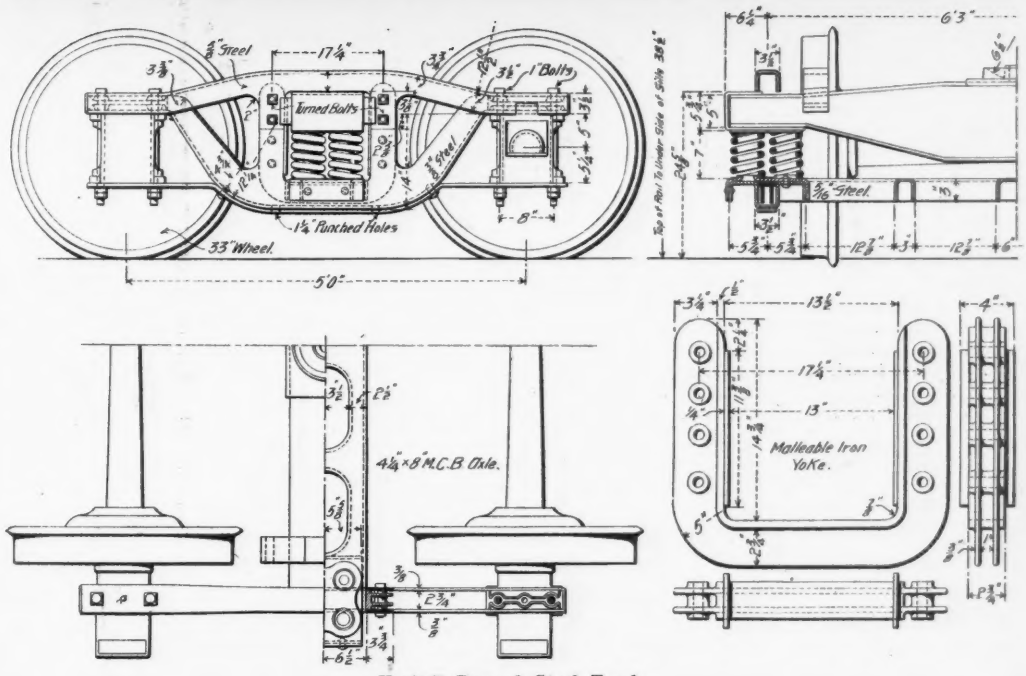
The Colorado special of the Chicago & North Western, leaving Chicago at 6:30 p.m., now runs through to Omaha in 12 hrs. 25 min., and to Denver in 26 hrs. 30 min. This is a reduction of 2 hrs. 30 min. from the best time to Denver heretofore. A passenger leaving New York at 5:30 p.m. Monday can reach Denver at 8 p.m. Wednesday.

Haskell Pressed Steel Truck.

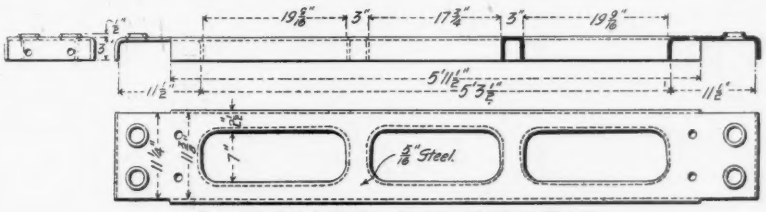
The design of pressed steel freight car truck shown in the accompanying illustrations has recently been brought out by Mr. B. Haskell, Superintendent of Motive Power of the Pere Marquette. The design is interesting and embodies some novel features.

The tension member of the side frame is of ⅜-in. metal, pressed to a U-shaped section. It has a depth of flange over the journal boxes of 3⅛ in. and at the center under the springs of 4 in. The compression member is of similar section and thickness to the tension member, has a depth of flange over the journal boxes of 3½ in. and 3 in. at the center. Both members have wings formed on them 3¾ in. wide, seen on either side of the springs in the illustrations. These wings have a malleable iron yoke bolted between them, forming rigid connections between the tension and compression members, and also forming guides for the truck bolster. This yoke is riveted to the tension member with four ⅞-in. rivets and bolted to the compression member with four ⅞-in. turned bolts. This arrangement does away with the objectionable column bolts of the ordinary arch-bar truck and also the heavy guide columns. To insure a perfect bearing over the journal boxes malleable iron filling boxes are inserted in the U-shaped section of the compression member. The journal-box bolts pass through the fillers and bars and are secured in the usual manner. The tie bars are ½ x 3 in. wrought iron riveted to the tension members by two ¾-in. rivets.





Haskell Pressed Steel Truck.



Pressed Steel Spring Plank—Haskell Truck.

The spring planks are pressed from $^{5}/_{16}$-in. steel plates and have an extreme width of 12 in. The side flanges are cut so that they will shoulder snugly against the inner faces of the side frames, thus relieving the four ¾-in. rivets, that secure the spring plank to the tension member, of any shearing stress. The springs are retained in place by two bosses formed on either end of the plank and which fit into openings in the spring plate. This spring plank weighs but 140 lbs., which is about 60 lbs. lighter than a steel-channel plank of equal strength. Additional lightness is secured by the three openings seen in the plan view of the spring plank.

The Pere Marquette has 500 cars running, out of a lot of 700 ordered with this truck, 200 of which are gondola

coal cars. Common Sense truck bolsters were used instead of the pressed steel bolsters shown in the drawing. The cars have been in service for some little time and thus far have given entire satisfaction, not having caused trouble of any nature. The truck is simple in design and easy of inspection.

Early History of the Delaware, Lackawanna & Western Railroad and Its Locomotives.*

BY HERBERT T. WALKER.

PART III.—HOW TRAMPS WERE HANDLED.

Until comparatively recent years tramps and rough characters used to board the trains, and personal courage was one of the qualifications of a good trainman. The late Edward King, who drove the "Orange," was in the employ of the company for nearly fifty years, and ran the "Easton mail" up to within a few days of his death, which took place in 1898, just as the writer had opened a correspondence with him.

King was not only a good "engineer," but a pugilist of some local repute, which latter accomplishment was put to use in the company's service on occasion. One day a party of hatmakers (each man wearing a fine silk hat) boarded a down train at Milburn. King was the driver of this train. The men were hilariously defiant, and when the conductor demanded the fares, swore they

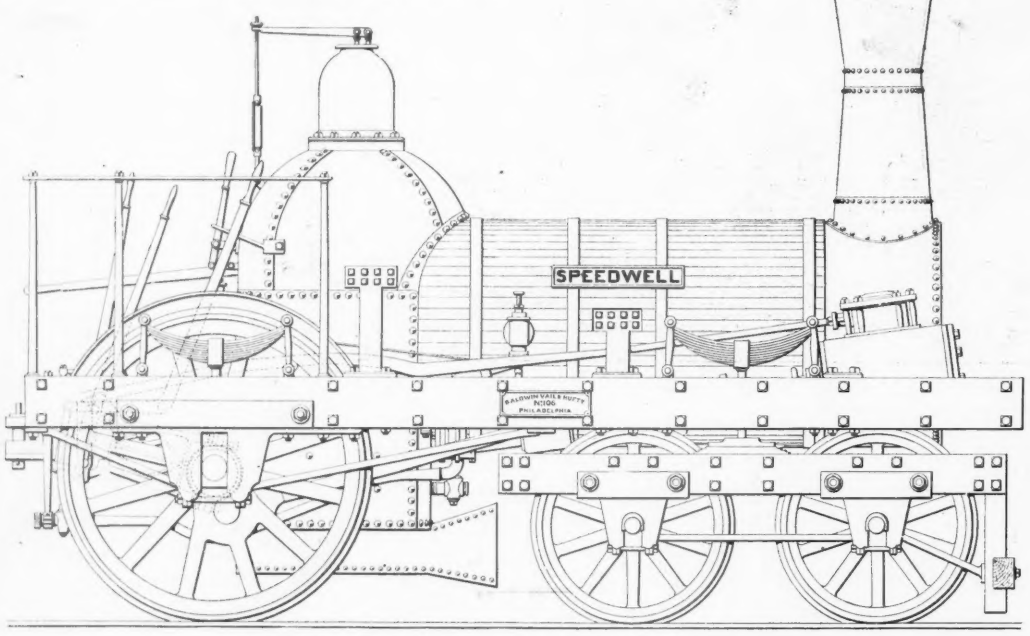


Fig. 5.—Morris & Essex Railroad Third Engine, 1838.

were on the free list and would ride to Orange without payment. The conductor, not seeing the matter in the same light as the invaders, stopped the train and called on the enginemen to help "put off tramps." Leaving the engine in charge of the wood passer, the redoubtable "Ed" went back with the fireman to see what was "up." On learning the state of affairs he headed the attack on the enemy with such vigor and scientific skill that in a few moments the hatters had fled to the woods, leaving their headgear scattered on the field. The best hats were then selected, it being unanimously agreed that to the victors belong the spoils, and the journey was resumed, every trainman wearing a "stove-pipe" as a trophy of victory, so that when the train drifted into Newark, the crowd of idlers were entertained by the novel sight of railroad men in silk headgear, and much laughter and joking resulted.

Such was railroading in the early days and, as regards passenger accommodation, the reader can imagine what it was to ride at a speed of 15 miles an hour, jolting over an uneven track in a dimly lighted and not over clean car, heated in winter by a small centrally located stove that radiated a fierce heat to those unfortunately seated near it, whilst the rest of the car was cold and draughty. Anon comes the conductor (who owns much real estate) swinging his lantern and collecting fares, as many or as few of which he will turn in to the company as he chooses. On stopping at a station, with neither platforms nor lamps, an alighting passenger would probably land knee-deep in a gully or pool of water to the amusement of the grinning brakeman. All these inconveniences were suffered without a word of complaint. To-day the palace car is scarcely up to the average passenger's ideas of comfort and luxury.

The third and fourth engines for this railroad were designed and partly built by Baldwin. It is reported that the before-mentioned Stephen Vail, who was some time superintendent of the M. & E. R. R., was one of Baldwin's creditors at the time that celebrated engine builder was involved in the financial difficulties of 1836-37. As part payment of the debt Vail accepted two locomotives in an unfinished state, which were completed at his Speedwell shops and named "Speedwell" and "Dover." They are illustrated in Figs. 5 and 6. It is only right to add that Baldwin, who was an honorable man, fully satisfied his creditors, paying the amount of all claims, principal and interest.

The books of the Baldwin Works show that the shop number of "Speedwell" was 106 and it was built in 1838.

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There is no specification of the engine except that the gage was 4 ft. 10 in. The engine was sent to the Speedwell works in 1839 and placed in service soon afterwards. At this period Baldwin's business was conducted under the name of Baldwin, Vail & Hufty. The leading dimensions of "Speedwell" were: Cylinders, 10½ in. diameter by 16 in. stroke; driving wheels, 54 in. diameter; weight, about 9 tons. It was of the inside connected half-crank design, but its most interesting feature was the valve motion, for there was but a single fixed eccentric for each cylinder. The eccentric strap had two arms attached to it, these arms extending back under the footboard with a D-hook on the inner side of the end of each. The rock-shaft had arms above and below its axis, and the hooks of the two rods of the eccentric were moved by hand levers so as to engage with either arm, thus giving fore or back gear. There was a hand pump on the footboard in addition to the regular pump, which latter was formed by making the guide bar (single) hollow, and using it for a pump barrel. The plunger was connected to a sleeve bolted on to the long piston rod. The hollow guide bar terminated in the vertical pump chamber, a portion of which can be seen just in front of the fire-box.

In a letter addressed to Baldwin from Lewis Condit, president of the M. & E. R. R., dated Jan. 1, 1840, this

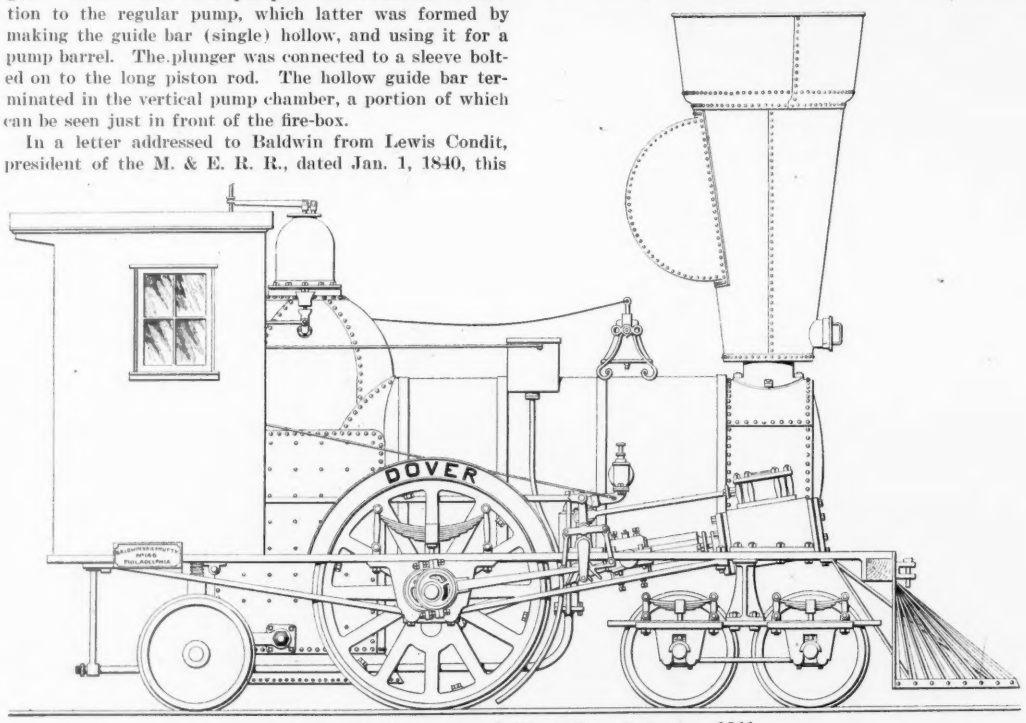

Fig. 6.—Morris & Essex Railroad Fourth Engine, 1841.

engine is described in favorable terms. He states that it ascended the Newark Hill with cars carrying 150 passengers, besides burthen cars with from 8 to 10 tons. This description is a little ambiguous, but it is evident that "Speedwell" was a more powerful engine than the "Orange" or "Essex."

The "Speedwell" was driven in 1838 by Mr. John Casson, who resides at Paterson, and is over 80 years of age. During a pleasant interview he stated that the engine worked well, but the reversing gear required some skill and practice before it could be handled expeditiously. Mr. Casson was an apprentice in the shops of Rogers, Ketchum & Grosvenor, and on serving his time there he went to Newark and was employed by Seth Boyden, who was practically the master mechanic of the M. & E. R. R. Mr. Casson described Boyden as a fine mechanic and a most lovable man to work for. In 1845 Mr. Casson was appointed master mechanic of the Somerville & Elizabethport Railroad (now the Central R. R. of New Jersey), and at about the same period the road was sold under foreclosure and reorganized in 1847 and Stephen Vail, who had a controlling interest in the new company was elected president. It is reported that the "Speedwell" was owned by Vail personally and never belonged to the M. & E. R. R., and when he was elected president of the Somerville Railroad he transferred the engine to the latter road, where it worked for several years.

It would also appear that Vail owned the engine "Dover" (Fig. 6), for the books of the Baldwin Locomotive Works show that the engine was built for him in the year 1841 (shop number, 146) and sent to Speedwell the same year. As we have seen, the engine was completed at the Speedwell shops and its chief dimensions were: Cylinders, 10 in. diameter by 16 in. stroke; driving wheels, 54 in. diameter. The engine had half-cranks and outside valve motion with drop V-hooks, all plainly shown in the drawing. The stack was of peculiar design and will be fully described later. The cowcatcher was made of the original strap rails of the road. At one time the bell was rung by the motion of the valve rod, but this was soon removed. Perhaps the most interesting part of the engine is the trailing wheels, which had a traction increaser. The parts cannot be well seen in the drawing, but the trailing axle had one spring running lengthwise. The tension of this spring was regulated by an adjusting screw which had a square head and wrench projecting up through the footboard. This axle had no pedestals, but was held by radius arms fulcrumed to the fire-box, as shown.

The early life of this railroad was accompanied by financial difficulties, as it went near no manufacturing town of any size except Newark, and the business was therefore light—the income falling short of the operating expenses. In the year 1841 there was a foreclosure and Superintendent Vanderpoel, who, by the way, was the leading spirit of the railroad and a heavy stockholder, bought the property in with the help of his associates, and practically reorganized it. Vanderpoel never lost faith in the railroad, and he spared neither time, money, nor himself to keep its head above water. His name, with that of President Lewis Condit, should be permanently recorded in connection with the M. & E. R. R. Vanderpoel did not live to develop his plans, for he died in December, 1842, aged 67 years.

About 1842 the engine "Orange" (Fig. 3) underwent some alterations, which are fully illustrated in Figs. 7 and 8. It was found that the original valve gear gave much trouble, for the engine could not be reversed when in motion. This was partly the cause of the disastrous "runaways" down Newark Hill, and a new valve motion was put on, as shown. This was done before the year 1842, but is more conveniently described here. Mr. Obadiah Boyden states that his father designed this valve motion, and, as far as he knows was the inventor of it. He also says that when the "Orange" was first built the wheel flanges did not stand wear, so the engine was put in the shop and the flanges turned off. Separate flanges were then made of flat bar iron and bolted to the wheels. As this was found unsatisfactory, the wheels were then turned down and tires shrunk on, as shown in Fig. 7. Several minor improvements were added from time to time, which are clearly illustrated in the drawing and need no description. It seems strange that the objection-

Fig. 2.—Press Department.

Fig. 3.—Er

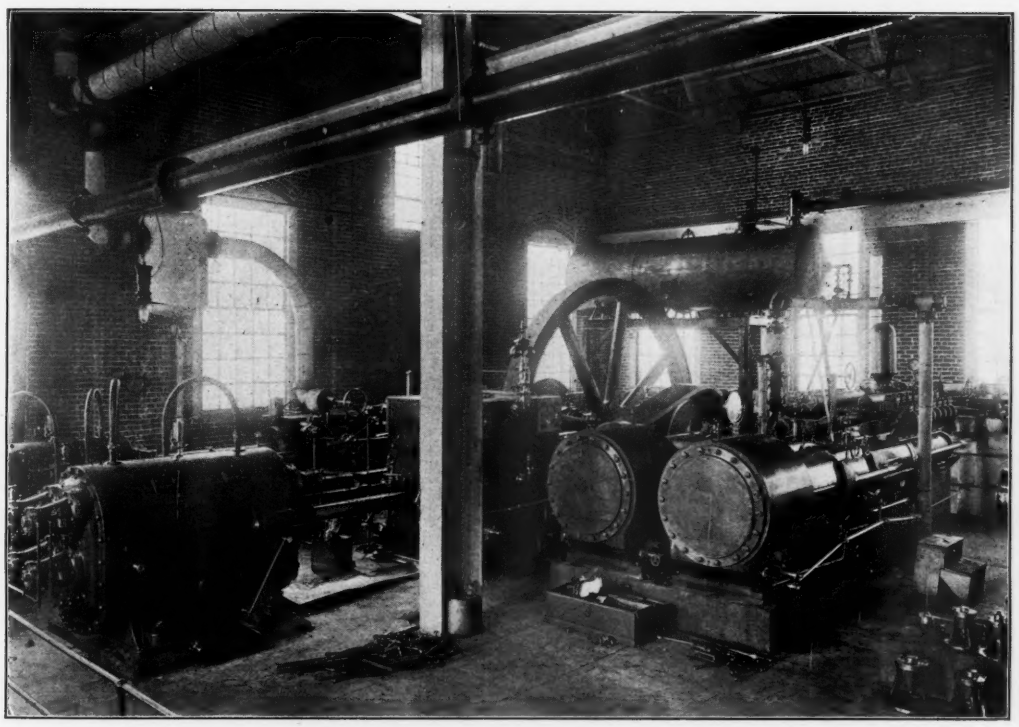

Fig. 5.—Air Compressors and Hydraulic Pump.

Fig. 1.—

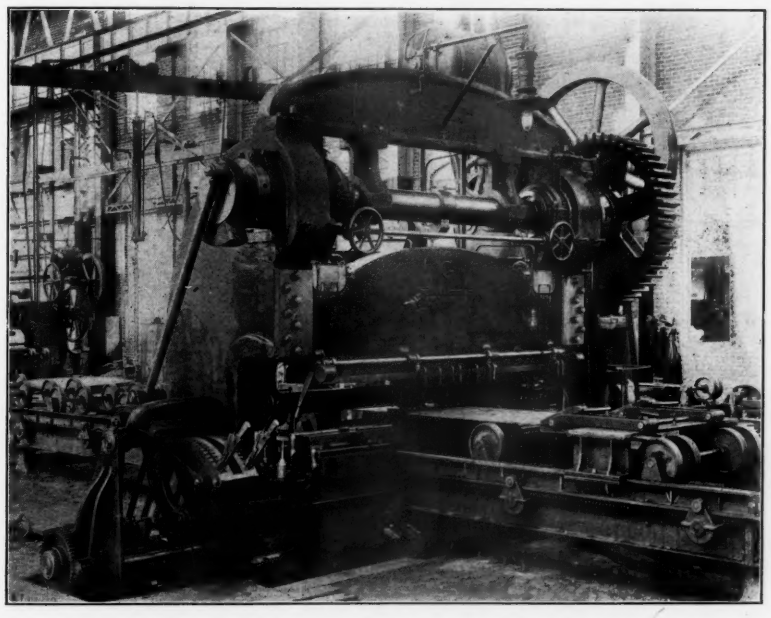

Fig. 8.—Multiple Punch with Automatic Spring Table.

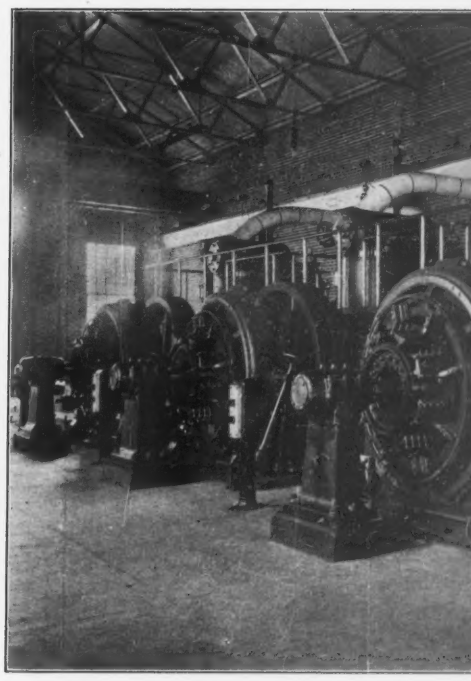

Fig. 4.—Power Stati

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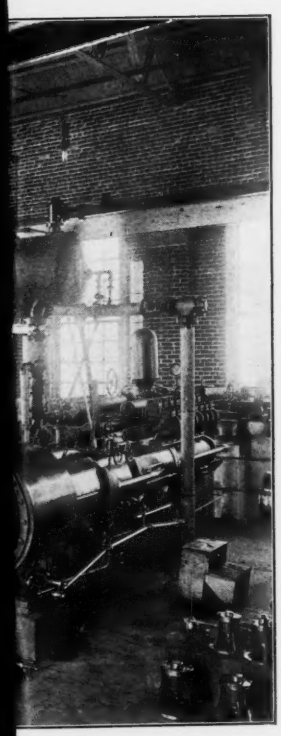
Fig. 3.—E



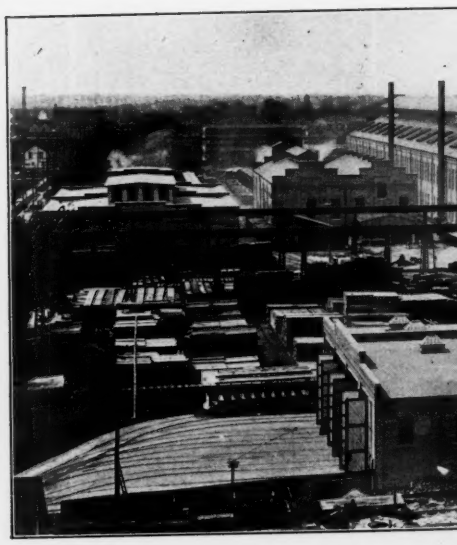


Fig. 1

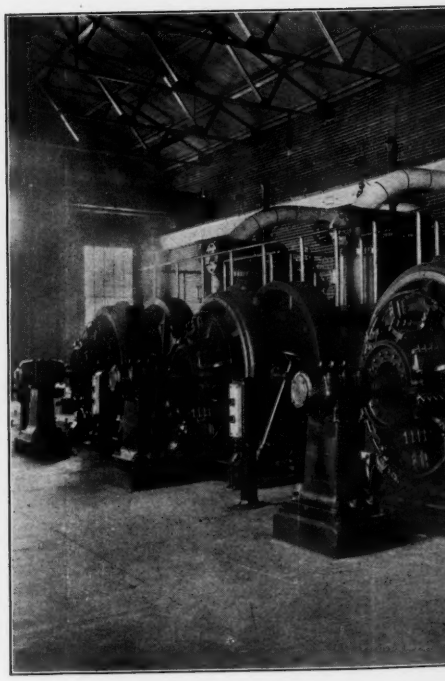


Fig. 4.—Power St

Fig. 3.—Erecting Department.

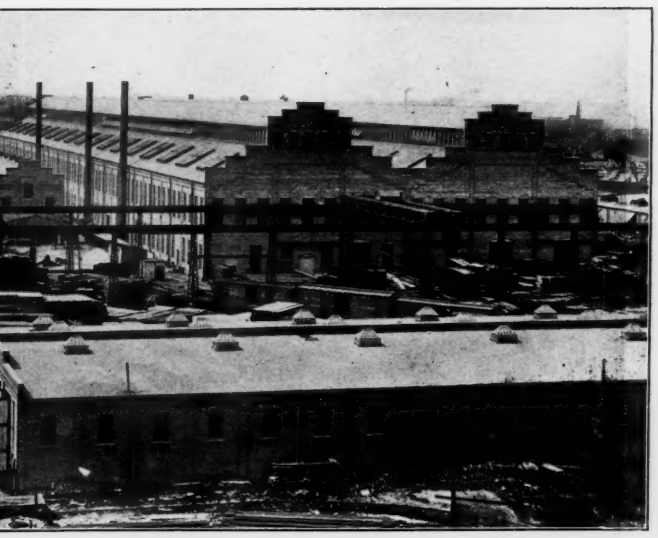
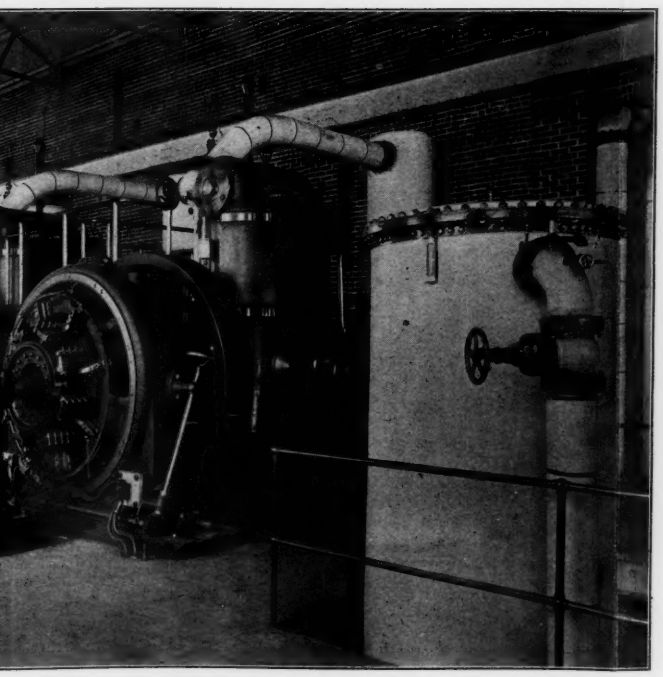


Fig. 1.—General View.



Power Station—Engines and Dynamos.

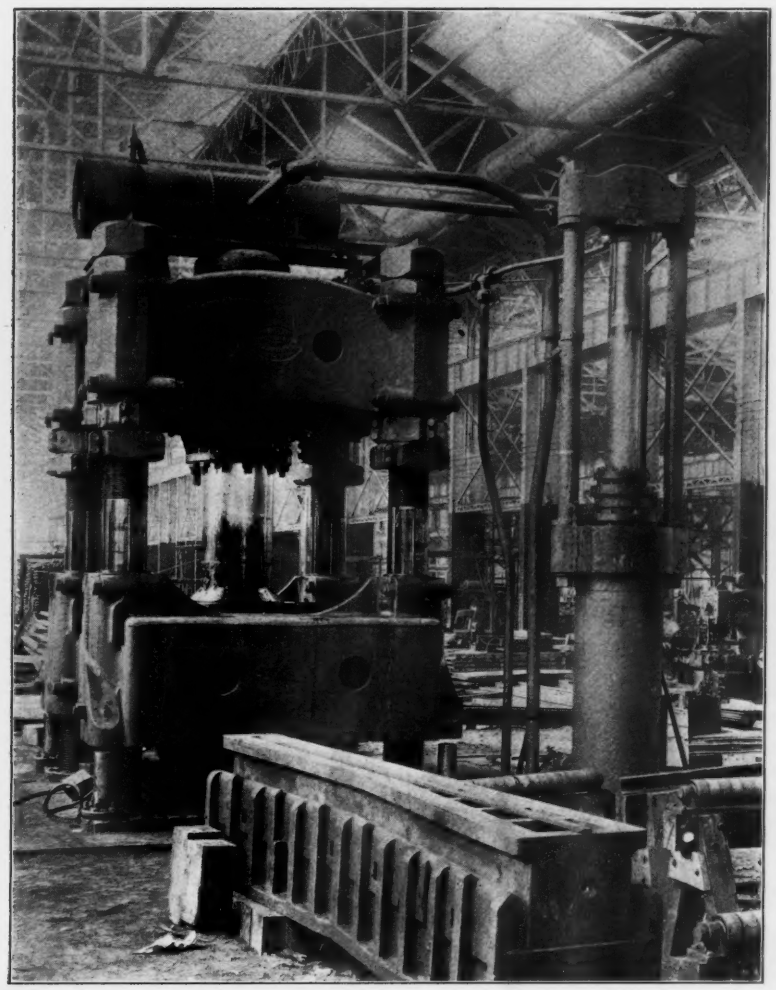


Fig. 7.—1,000-Ton Hydraulic Press.

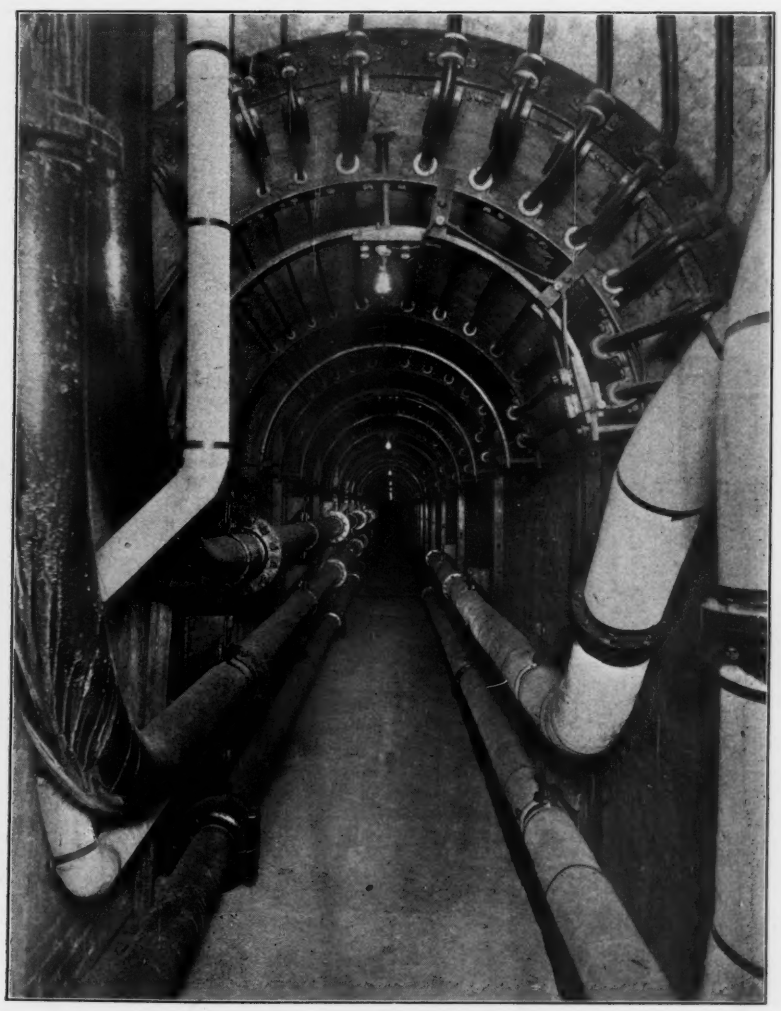
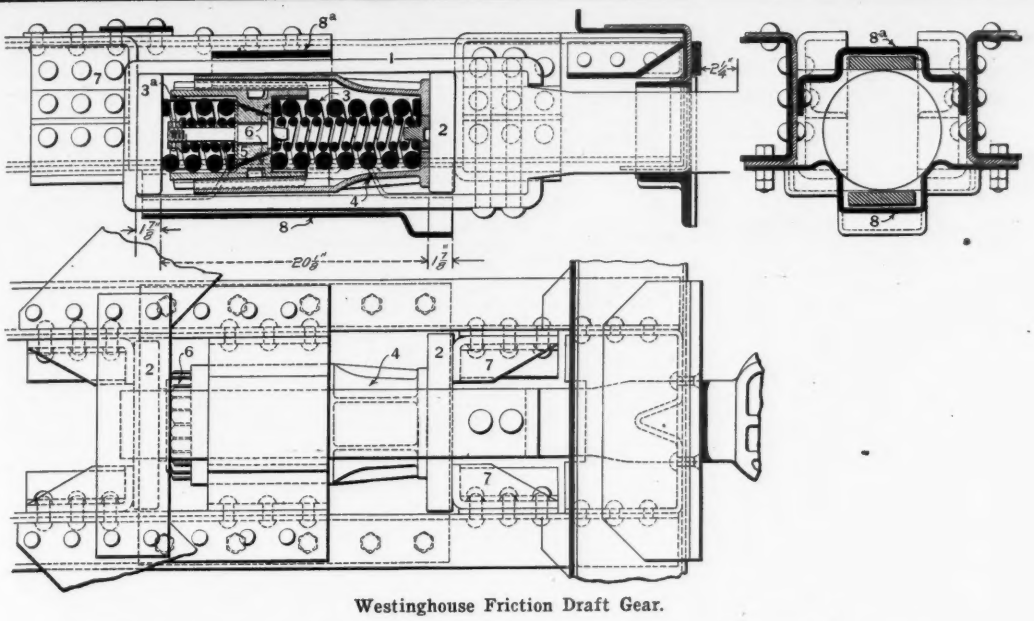


Fig. 6.—Tunnel Between Power Station and Shop.



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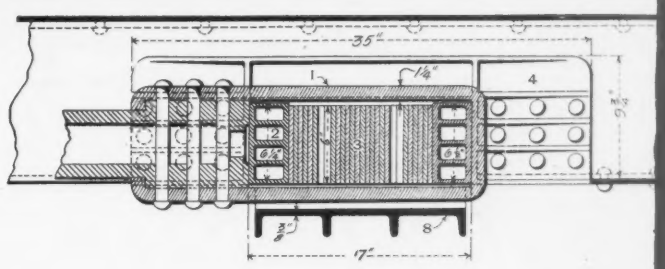
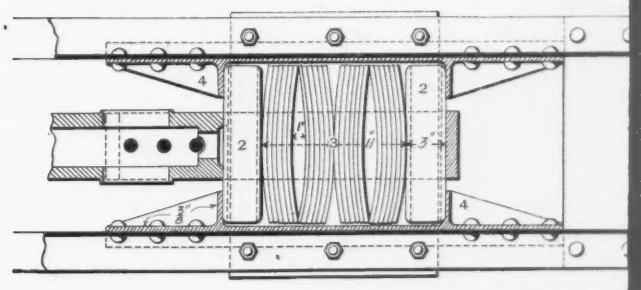
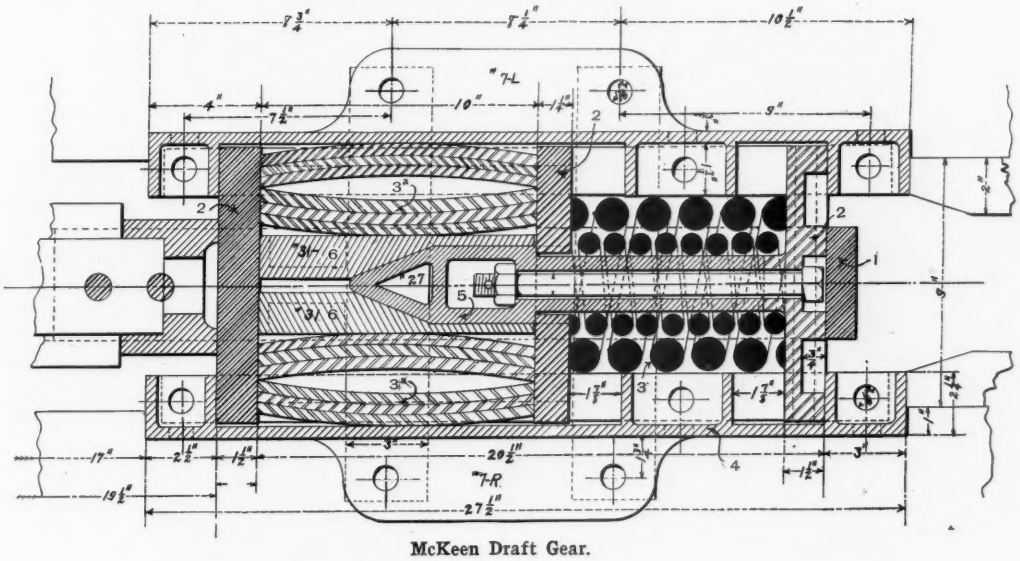
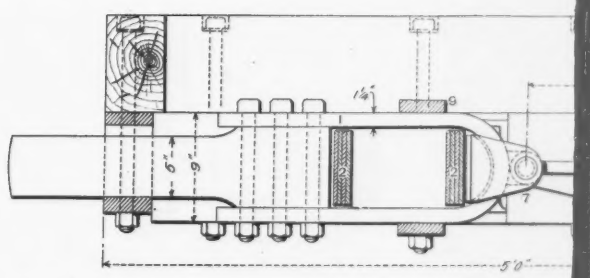


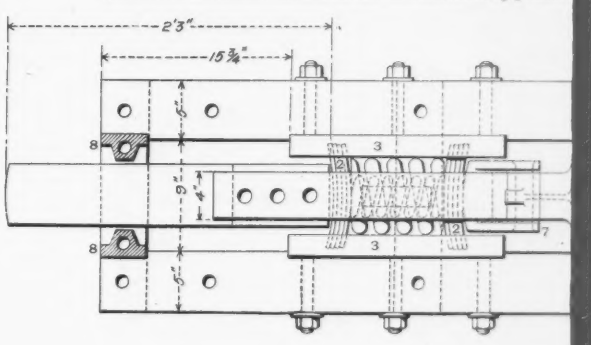


The O. and C. Friction Draft Gear.

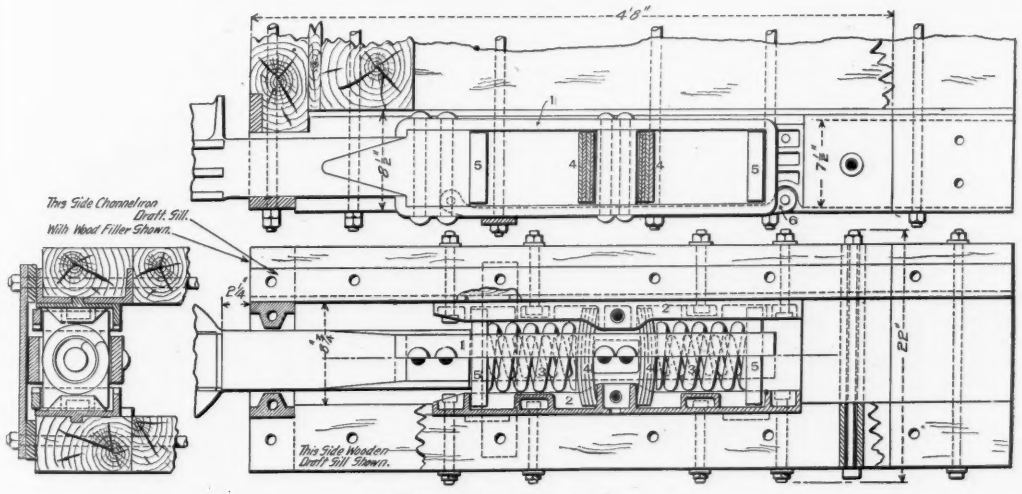


McKeen Draft Gear.

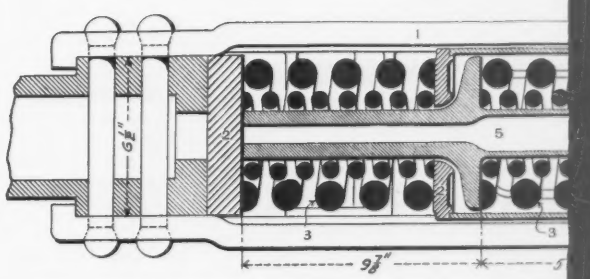


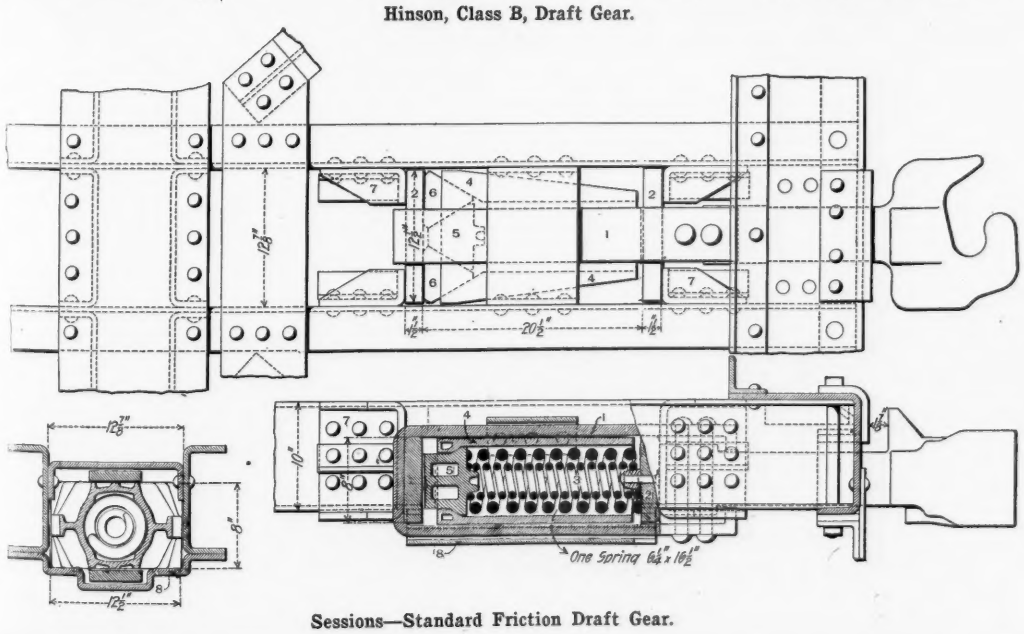


Hinson's Auxiliary Friction Draft Gear.

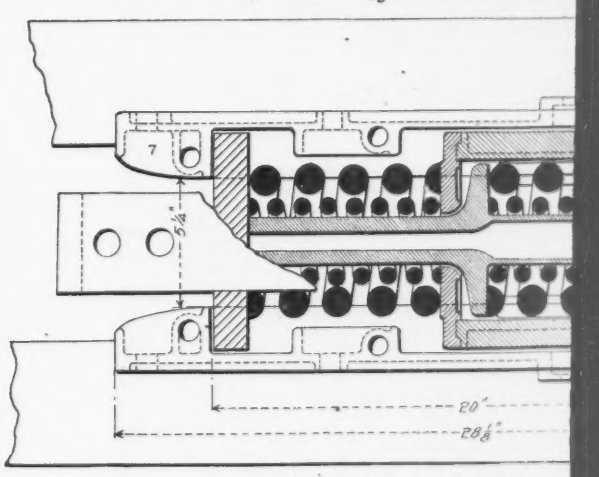


Hinson, Class B, Draft Gear.

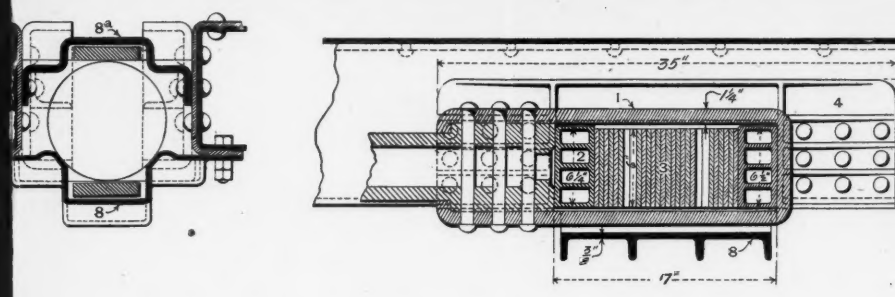


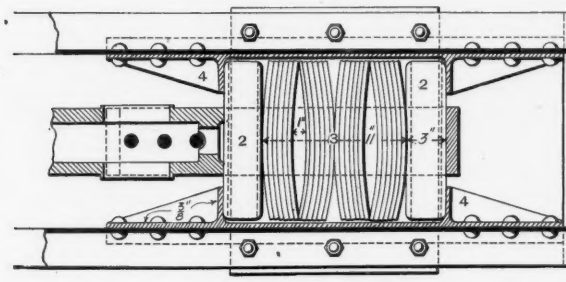


Sessions—Standard Friction Draft Gear.

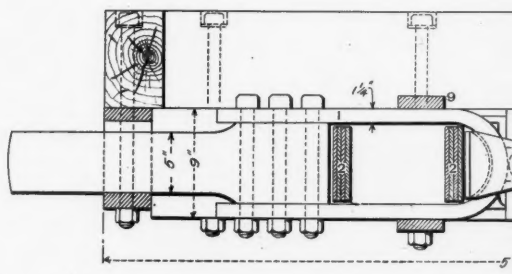


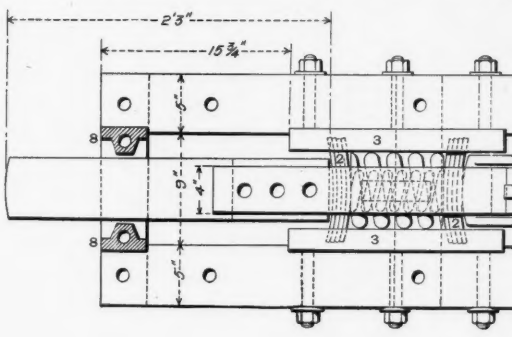
Butler Draw-bar Attachment.



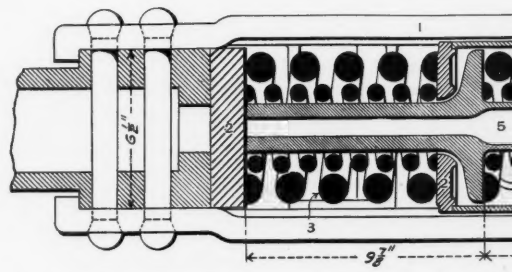


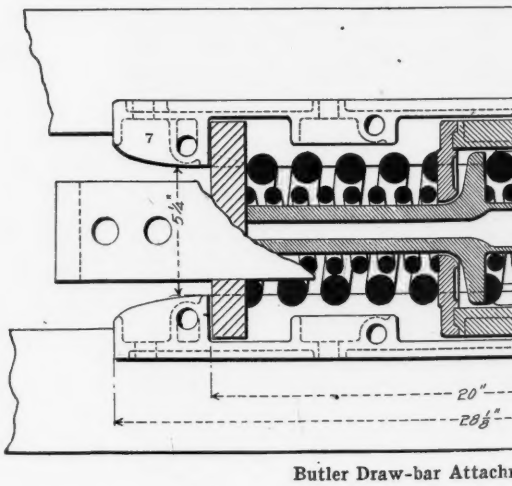
The O. and C. Friction Draf





Hinson's Auxiliary Friction Draft





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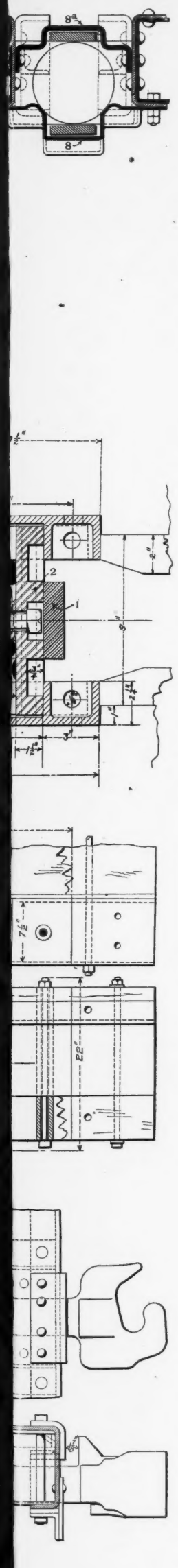
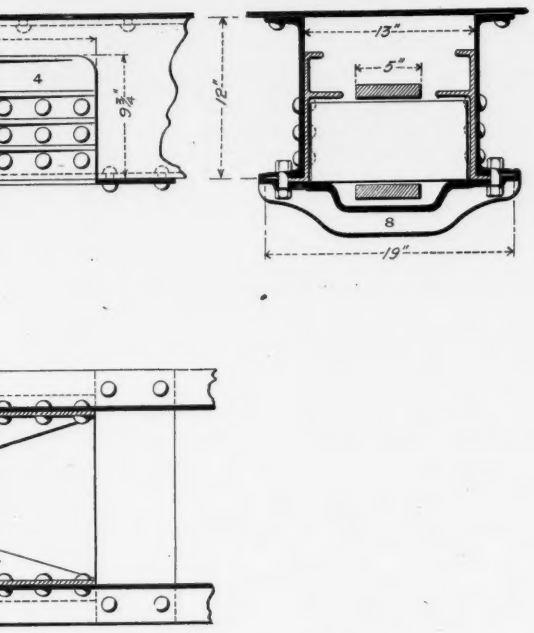


SOME MODERN DRAFT



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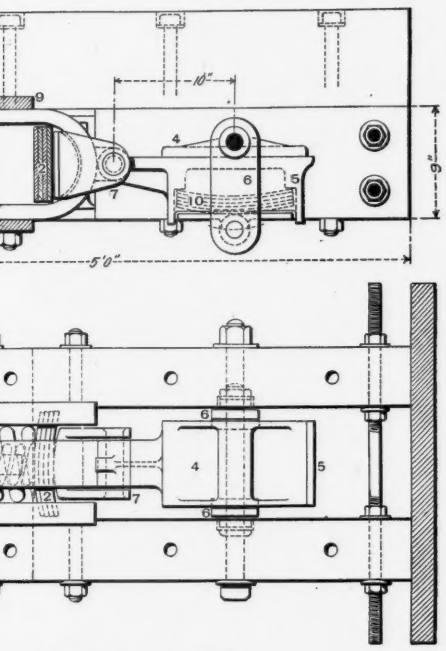
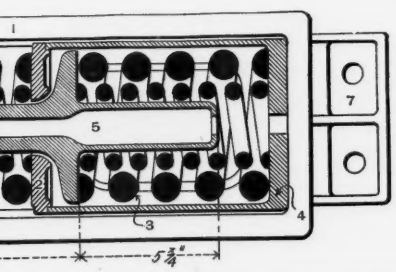
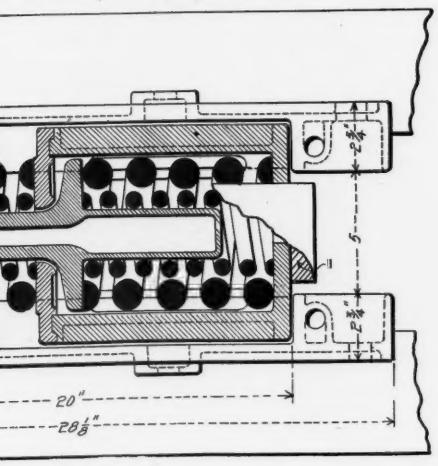


ction Draft Gear, Class F.





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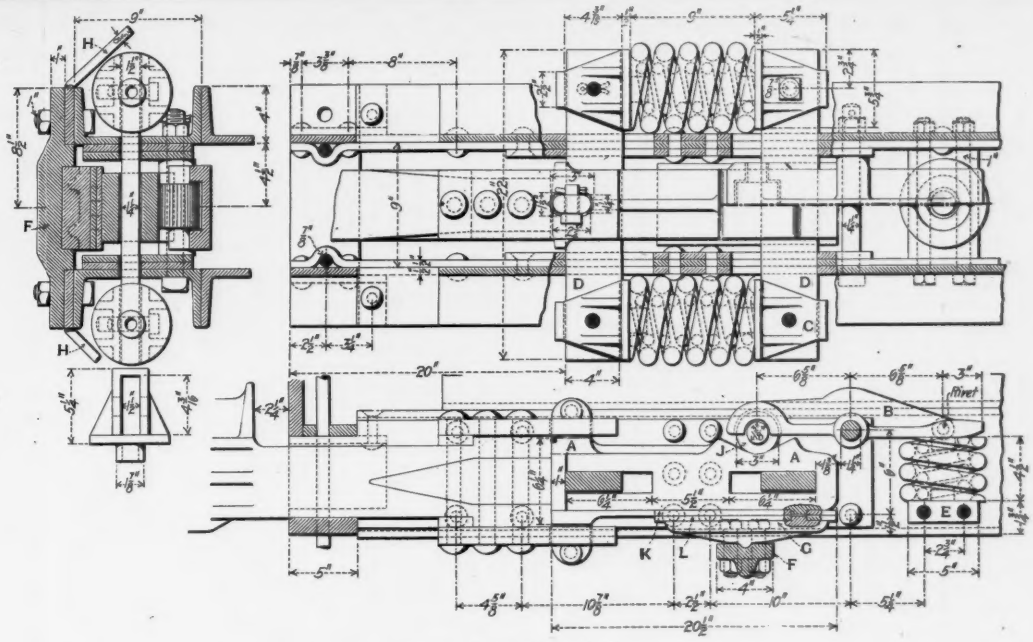
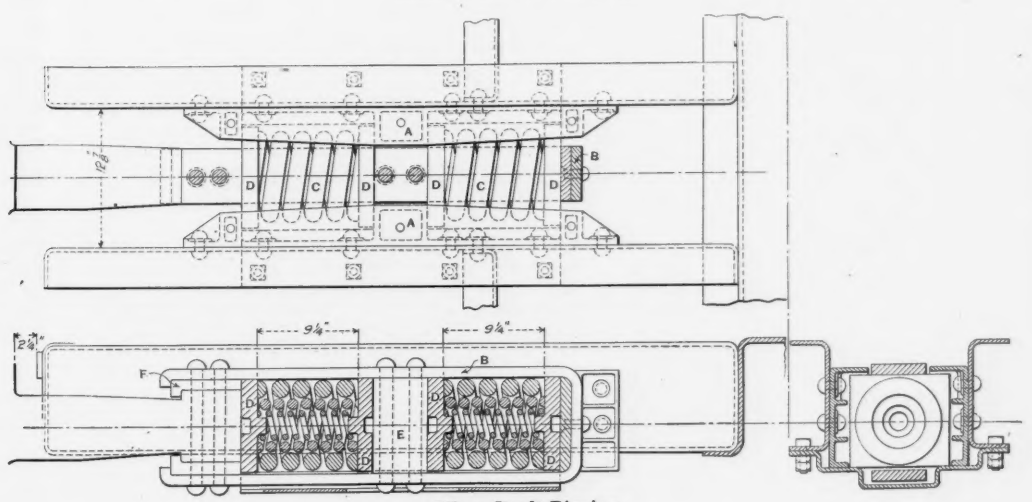
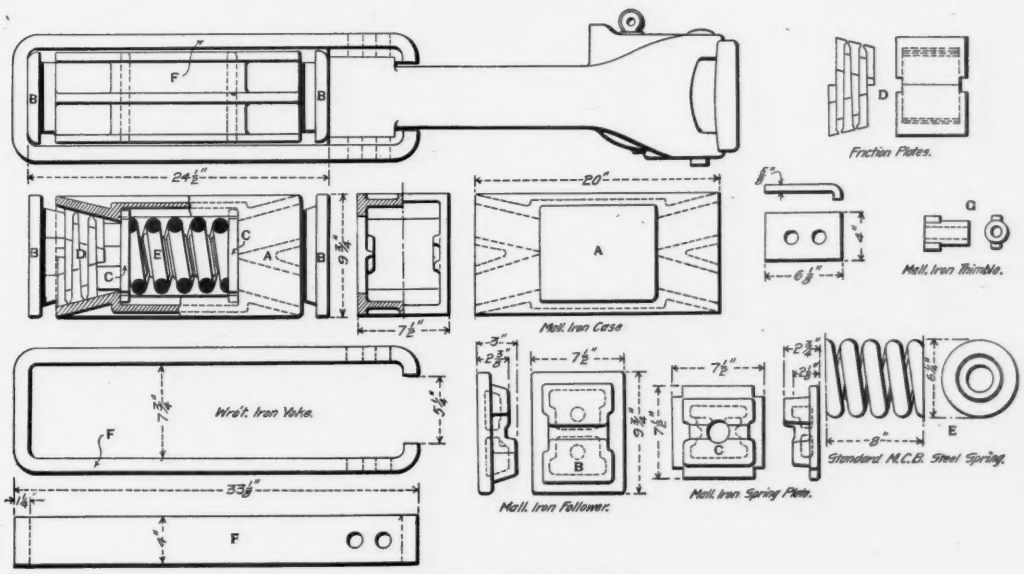
N DRAFT GEARS.



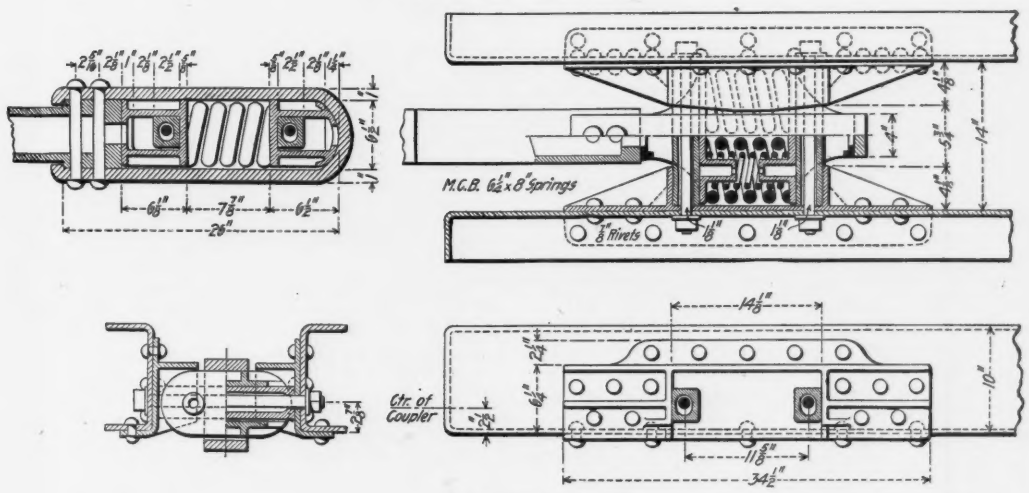
Hinson, Class C, Draft Gear.



Miner Draft Rigging.



Hien Friction Draft Gear.



Dayton Draft Gear.

able position of the pump check valve (on the fire-box) was not altered, but it remained there as long as the engine lived. The cowcatcher was made of the same materials as that of the "Dover." At this period the M. & E. R. R. Co. had but one headlight, and it was changed from one engine to the other, as required.

The valve gear and smokestack will now be described, the details being shown in Fig. 8. The engine was reversed by a horizontally disposed lever fixed to a cross-shaft, which went over the fire-box so as to operate the motion on both sides. We will describe the side in view.

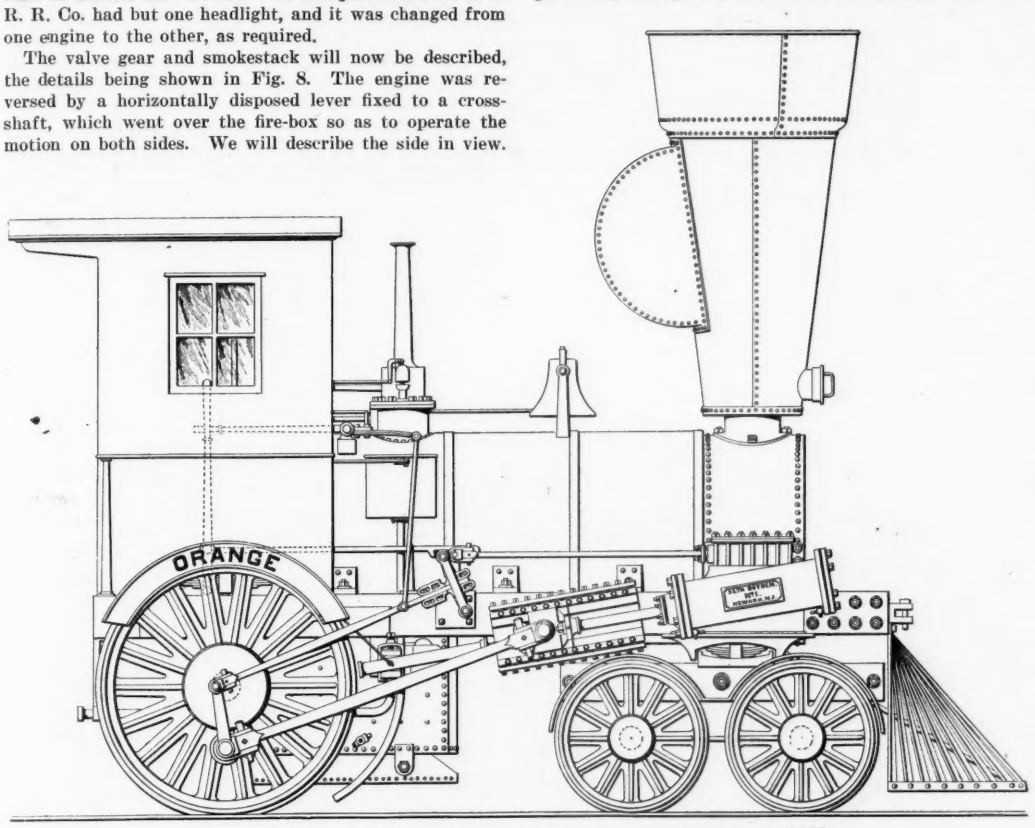


Fig. 7.—Morris & Essex Railroad First Engine as Rebuilt About 1842.

By a leaf spring clamped to said cross-shaft the eccentric rod and D-hooks were moved up and down so as to engage with one of the pins of a double rocker arm whose shaft, journaled on the main frame, carried the usual rocker arm and valve rod. The purpose of the leaf spring was to keep the D-hooks in snug engagement with the required pin of the double rocker in all the positions the various parts would assume during a complete revolution. It is obvious that when the reversing lever was horizontal and the hooks free of the rocker pins the engine was out of gear, as shown in Fig. 7. In Fig. 8 the engine is shown in forward motion. The vertical lever or "starting bar" had a reach rod having two gabs to move the valves by hand until the leaf spring caused the D-hook to snap on to the required rocker pin.

The spark arrester was patented by J. V. L. Hoagland, March 18, 1842. As will be seen by the sectional detail, the inner smoke-pipe was curved over to throw the sparks into a semi-circular pocket, in which they traveled until they struck a V-shaped deflecting plate, when they fell on to the floor of the outer stack, the smoke and steam passing out through the wire bonnet. It was a good spark arrester, but the bend on the inner pipe soon got battered out. As these old engines cut off at full stroke, the exhaust was heavy in proportion to their size.

In 1843 the company's time-table was as follows: Two round trips from New York (via New Jersey Railroad & Transportation Co.) to Morristown. From Morristown the trains departed at 7.00 a. m. and 3.30 p. m. From New York the times of departure were 8.00 a. m. and 4.15 p. m. The time from New York to Newark was one hour, and 2½ hours from New York to Morristown. The speed was the same as at the opening of the road. Two horse-car trips were made during the day between Newark and Orange.

Up to this period the engines hauled freight or passenger trains as required, but as the traffic increased the desirability of having a "powerful" engine for freight service began to be seriously considered, although some of the directors held the opinion that a freight engine was an expensive luxury, not to be rashly indulged in, costing as it would something like $8,000. It appears, however, that a very energetic locomotive builder named Thomas Rogers, of Paterson, N. J., was anxious to get an order from this railroad and offered to build them an engine on favorable terms. Accordingly, we find in the "Order Book" of Rogers, Ketchum & Grosvenor, under date of Dec. 17, 1844, an entry stating that Mr. Rogers made a proposition to B. Vanderpoel and J. W. Condit, "Committee on Cars and Locomotives," to build them an engine and tender for the sum of $7,700. As an extra inducement, Rogers agreed to place his "patent graduating cut-off valve" on the engine, by which an unheard-of economy of fuel would result. As the railroad was in no hurry for the engine, it was not delivered until May 18, 1846. It was the 82d engine built by Rogers, and cost $50 more than the contract price. This engine was named "Sussex" and is illustrated in Fig. 9, the leading dimensions being: Cylinders, 13½ in. diameter by 20 in. stroke; driving wheels, 54 in. diameter; weight, about 18 tons. The valve motion is important, showing, as it does, one of Rogers' many attempts to get a variable cut-off. The valve chest was double, having, as the enginemen called it, "two stories." The lower one was for the main valve, which cut off at full stroke, and was actuated by the usual drop V-hook motion. The upper chest had two ports in its valve seat and two slide valves, one for each port. These valves were solid (no exhaust cavities) and admitted steam into the main valve chest. The said two valves had separate stems, one (solid) sliding within the other (hollow), which was provided with a stuffing box, as shown. The hollow stem was linked to the upper arm of a T-lever fulcrumed to a bell crank lever linked to the cross-head (this bell crank lever also worked the upright feed pump), and the solid stem was linked in like manner to the lower arm of the T-lever, said lever being operated by a bell crank lever whose shaft passed over the boiler, and was moved by a reach rod and handle, having notches and a binding screw to retain it in any desired position. It is evident that when the T-lever was moved, its upper and lower arms would cause the valve stems to travel in opposite directions, placing their respective slide valves near to or far from each other, which was equivalent to increasing or diminishing the lap, and thus varying the steam admission or cut-off. The theory of this variable cut-off (patented by Rogers, May 1, 1845) was correct, but there were practical objections which caused its removal. The stuffing box of the top valve chest was then plugged up, and the steam worked by the main valve alone.

This was a powerful engine in its day and did long and efficient service. Mr. Thomas Keenan ran the "Sussex" in 1854, a cab having by that time been added, and the cut-off removed. Mr. Keenan is still in the company's service, driving the Easton mail train, which position he took on the death of Edward King, previously mentioned. When not running, Mr. Keenan is occupied in evangelical work, and his broad and genial presence is a power for much good in the remarkably well conducted work of the Railroad Branch of the Y. M. C. A., at Hoboken terminus. Were there more railroad men of Mr. Keenan's stamp, a better understanding between officers and employees would obtain, with a correspondingly less frequent occurrence of labor troubles and strikes.

(To be Continued.)

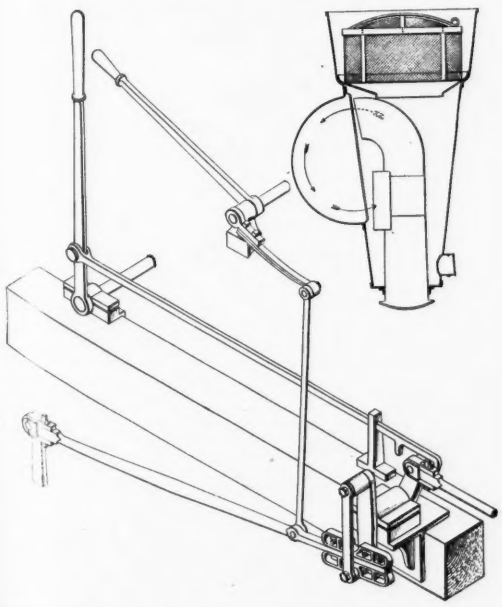


Fig. 8.—Morris & Essex Railroad—Details of Valve Gear and Spark Arrester; Engine "Orange," 1842.

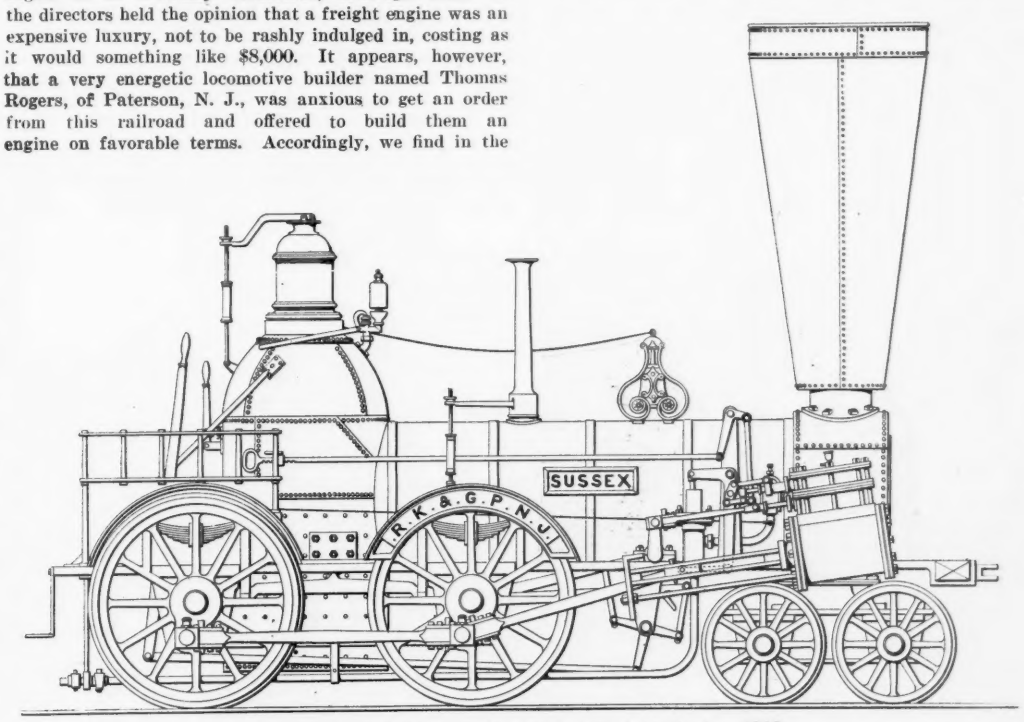


Fig. 9.—Morris & Essex Railroad First Freight Engine, 1846.

Adjustment of Per Diem on Switching Roads.

Secretary W. F. Allen, of the American Railway Association, has issued on behalf of the Committee on Car Service the following circular. The circular is self-explanatory.

New York, June 2, 1902.

"The Committee on Car Service calls special attention to Rule 5 of the Per Diem Rules, which go into effect on July 1st:

"Rule 5.—An arbitrary amount for each car in switching service may be reclaimed by the switching line from the road for which the service was performed. This amount shall be based upon the average number of days actually required, and determined by the roads directly interested for each local territory.

"It is the intent of the Association in this rule that the representatives of the railroads in each local territory shall meet and decide how much relief the roads in switching service can justly expect. They must decide what part of the per diem charge shall be borne by the railroads participating in the freight rate, or, as the rule phrases it, what portion shall be borne by the road for which the service is performed.

"The rule is framed to cover not only belt railroads, but all railroads doing switching for others. For instance: Several railroads may connect at a point where each does switching for the other. Under rule 5, the representatives of these railroads will meet and, on considering the local conditions, may find that the time required for the switching movement of a car is 24 hours in each direction, and that the time for loading or unloading is 48 hours, a total of four days. It will, in such a case, be equitable to allow for each car switched a reclaim of 80 cents, equal to the per diem rate on four days.

"In certain localities there is a considerable amount of switching done between one railroad and another by an

intermediate railroad which does not involve the delivery of freight to consignees, or the receipt of freight from shippers. In such cases it may be found that the time required for the switching movement is 24 hours, and it would be fair to allow to the intermediate railroad a reclaim of 20 cents for each car switched.

"Where such arrangements are made, the railroad doing the switching should at the end of each month present to the railroad for which it has performed switching service, statements of the initials and number of each car received, with dates, and after these have been checked, proper bills for the reclaims should be rendered at the agreed amounts.

"It is obvious that under this arrangement, whenever a switching railroad is able to return a car within the time allowed, it will gain by the operation, while if it delays cars beyond the time allowed, it will lose.

"The Committee on Car Service calls this matter to the attention of the railroads of the country and suggests that such arrangements should be made as promptly as possible where switching service is performed, in order that these agreements may be in operation on July 1, 1902."

An Improved Journal Bearing.

The question of journal bearings is one that has probably received as much attention as any other one subject among motive power and car men and the matter of what may constitute the best combination of metals to compose these bearings has been much discussed and has formed the basis for numerous experiments. Alloys and bearing metals of various makes and compositions have their advocates. But below all of this is the fundamental fact that no matter what merit a particular bearing metal may possess, if the journal is not properly lubricated the results are unsatisfactory. In a paper before the April meeting of the Western Railway Club Dr. Gustav Thurnauer, of the Aurora (Ill.) Metal Co. read a paper on alloys in which he quoted this statement from a recent work of Dr. Charpy, who is an accepted authority on anti-friction alloys: "Experiments have demonstrated conclusively that the coefficient of friction in the case of well-adjusted bearings depends exclusively upon the nature of the lubricant regardless of the metals in contact."

Some three years ago the Great Northern was having a great deal of trouble with hot boxes on its overland trains. The trouble became so serious that the car foreman was instructed to take the matter in hand, ride the trains and if possible remedy the difficulty. An examination of brasses removed led to the conclusion that with the ordinary form of bearing most of the lubricant was scraped off at the lower edge of the brass where it comes in contact with the journal, and a means to correct this was sought. His efforts resulted in the production of a brass of the form shown in the accompanying engraving and its use in an experimental way was begun by the Great Northern. That it has been satisfactory is evidenced by the fact that it has been adopted as the standard brass of this road, and a letter from Superintendent P. L. Clarity, written early in 1901, says that not a single hot-box had come to his notice on cars having this brass since their adoption a year before.

An Improved Journal Bearing.

Tests conducted by the Great Northern during the experimental period, extending over three months and made for the purpose of determining the comparative oil consumption of standard brasses as against the new grooved brasses gave results as follows:

Standard brasses, oil used on 4,972 cars	5,754 gals.
Grooved brasses, oil used on 4,194 cars	2,678 gals.
Consumed by standard brasses per car	1.45 gals.
Consumed by grooved brasses per car	0.638 gals.
Saving in favor of the grooved brasses	56 per cent.

The figures for loss of metal by wear were:

Standard brasses, wear for 236,842 miles	12 lbs. 10 oz.
Grooved brasses, wear for 290,956 miles	4 lbs. 15 oz.
Loss on standard brasses per 1,000 miles	0.7864 oz.
Loss on grooved brasses per 1,000 miles	0.2715 oz.
Saving in favor of grooved brasses	65 per cent.

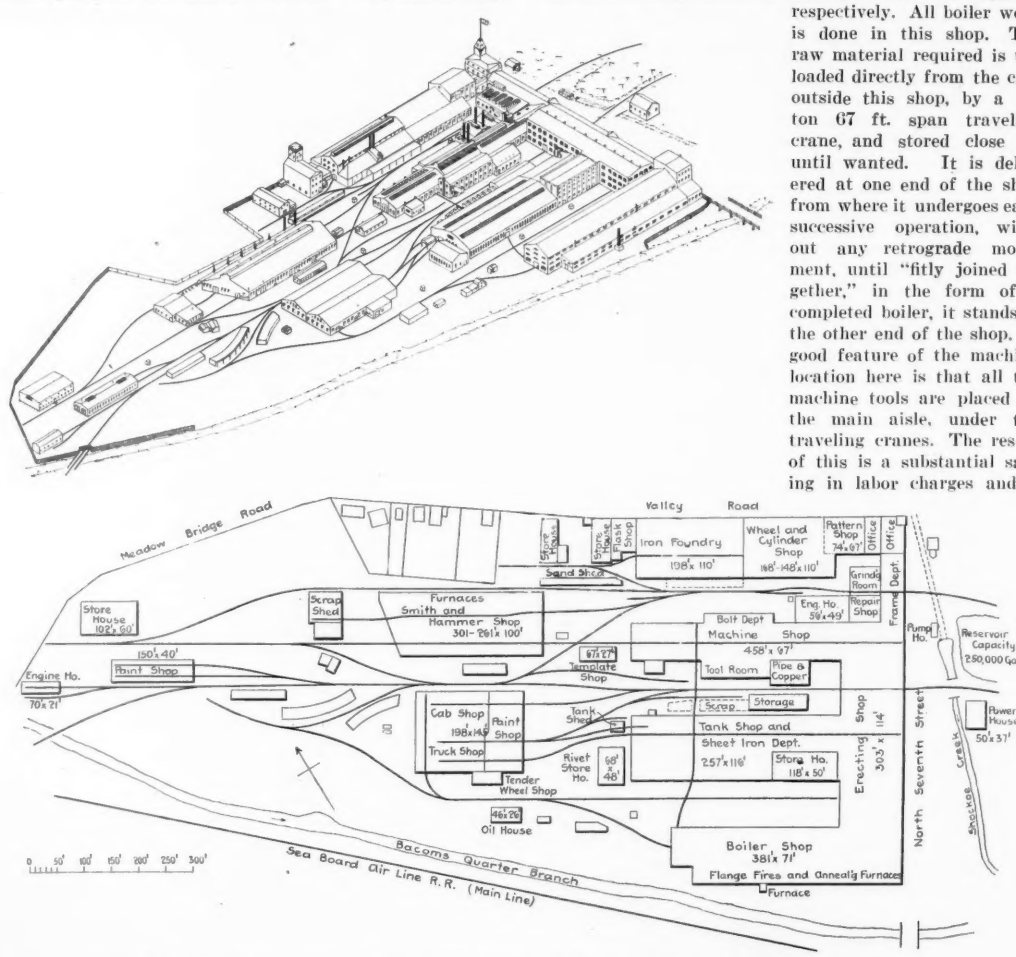
The discrepancy in the figures for relative oil consumption may be due in part to the fact that with the standard brass the thin film of oil which reaches the crown of the bearing is carbonized by the friction-heated surfaces while the grooved brass allows a sufficient quantity of the lubricant to reach the crown to keep the bearing cool.

Just what saving a reduction in friction at the journal bearings will effect in the coal consumption and in other operating expenses is a complicated question and one in a measure indeterminate. Experiments covering a long period and a variety of conditions would be required to furnish the data for such calculations.

The feature of difference between the grooved brass, called the Knapp grooved brass, after its inventor, Mr. B. J. Knapp, car foreman of the Great Northern, and the standard brass is a simple one and may be applied to the latter readily by means of a milling machine. Correspondence relative to these brasses should be addressed to the St. Paul Metal Co., St. Paul, Minn.

The American Locomotive Company's Richmond Shops.

The American Locomotive Company's shops in the South have long been known as the Richmond Locomotive Works. When first opened for business they were operated by the Tanner & Delaney Engine Co., and stationary engines and boilers were built. The second stage of development was reached when the Richmond Locomotive & Engine Works replaced the original concern. At the present time as the American Locomotive Co.'s southern plant, these works occupy about 25 acres of land, employ about 2,000 men, and are capable of turning out 20 engines a month.

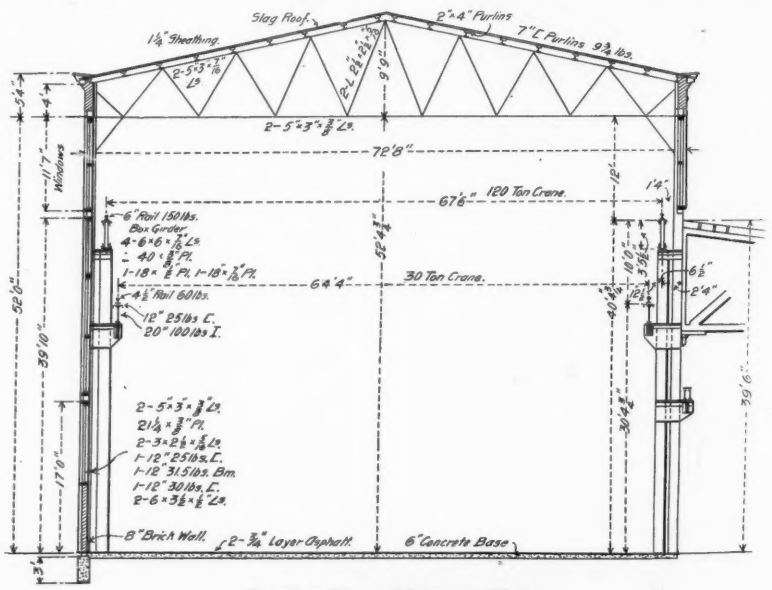


General Plan and Perspective View of the Richmond Works, American Locomotive Company.

In looking over the ground plan it is perhaps safe to say that some of the departments might have been arranged differently if the entire plant had been designed and laid out at one time, but though this is somewhat of a truism when applied to this or any similar organization, yet the relative arrangement of shops is good, and in some cases, with satisfactory facilities for handling material, the cost of transferring has been reduced to a minimum.

The plant is well supplied with fast electric cranes, and all the machine tools are of the heaviest and most modern types. The shops, which are completely equipped with electric power, are the wheel and cylinder shop, the foundry, pattern shop, boiler shop, tank shop, erecting shop and frame shop. All the others are using a considerable amount of electric power, and all the lighting is electric. Current is supplied for power purposes by two 100 k.w. generators, one belted and one of the direct connected engine type, at 240 volts. There are also two 200 k.w. capacity rotary converters driven by a 2,300 volt 3-phase alternating circuit from the James River water-power plant of the Richmond Electrical Railway & Development Co. This latter is an institution of which Richmond is justly proud—but, "that is another story." The little electrical transforming station at the locomotive works gives a large reserve of power and practically makes the works independent of a possible failure in coal supply, as far as power is concerned. The shops are wired for multiple voltage, by which variable speeds can be readily obtained in the motors. Most of the heavy or isolated tools are driven by separate motors, while the smaller tools are driven in groups, with a single motor to a group.

The new boiler shop has been completed a little more than a year. It is 420 ft. long by 102 ft. wide, and is 40 ft. high, measured up to the roof truss. The shop is well lighted by ample skylights; indeed, this may be said of the other shops as well, a great improvement having been made all through in this important matter. The main building of the boiler shop is spanned by two electric traveling cranes of 10-tons and 30-tons capacity respectively. All boiler work is done in this shop. The raw material required is unloaded directly from the cars outside this shop, by a 10-ton 67 ft. span traveling crane, and stored close by until wanted. It is delivered at one end of the shop from where it undergoes each successive operation, without any retrograde movement, until "fitly joined together," in the form of a completed boiler, it stands at the other end of the shop. A good feature of the machine location here is that all the machine tools are placed in the main aisle, under the traveling cranes. The result of this is a substantial saving in labor charges and a reduction of time loss in successive operations.

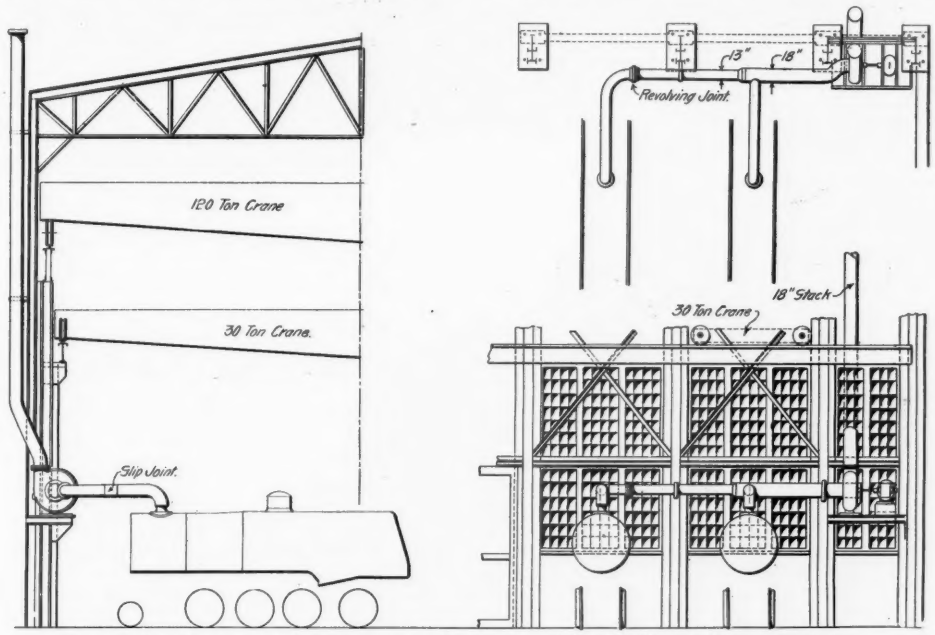


Erecting Shop—Richmond Works.

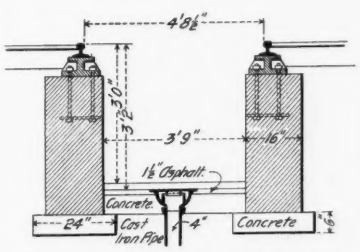
The tool room has been considerably enlarged; new machines have been added. On the ground floor in a separate room a small drawing office has been placed where work connected with new building construction and shop maintenance is done. Up-to-date appliances have been put in the tool room for the Taylor-Whyte process of treating tool steel, and upstairs in a bright, cheerful room along with additional equipment a very neat foreman's office catches the eye. While on the matter of tools, it may be said that here and there in the machine shop are various sets of lockers, all of uniform size, and capable of indefinite expansion, like the box shelves of the so-called, elastic book cases, in which

the machinists keep their small personal tools and "handy rigs" under lock and key.

A new erecting shop is being put up, as shown in the illustrations. It is to be modern and first-class in every particular. It is expected to be completed during the summer. It will be 303 ft. long by 72 ft. wide. The present erecting shop will be combined with it, and so form a lean-to with lower roof pitch. The new portion will be 52 ft. high in the clear, under the roof truss, and will be spanned with a 120-ton electric traveling crane of 40-ft. lift. A 30-ton crane of 30-ft. lift will also be installed. The larger crane will be on a separate runway 10 ft. above the smaller one, and will be used, among other services, for lifting an entire engine and transferring it from one track to another. The shop will contain 17 tracks, placed at right angles to its length. Two of these will be delivering tracks connecting with the railroads. Two tracks will be devoted to testing boilers. The American Locomotive Company believes in firing up each boiler in its own fire-box and testing under steam generated in the boiler under examination. It is thought that this method is the only certain way of developing the leaks which may be caused by the unequal expansion due to a fire in the fire-box of the boiler itself. The process is identical with service conditions. This concern does not, however, believe in filling its shop with smoke and vapor every time a boiler test is made. Instead of treating the matter as a sort of "necessary evil," it looks upon the test as an orderly step in the process of manufacture, and provides appliances to meet the case. At the two testing tracks there will be installed an induced draft apparatus for carrying off the smoke and stimulating the fire. This contrivance forms the subject of a separate illustration.



Proposed Induced Draft Arrangement for Locomotive Boiler Testing—Richmond Works.



Section of Pit—Richmond Works.

The new erecting shop is placed very conveniently in relation to the other departments which supply it with finished material. The boiler shop immediately adjoins the south end, and the boilers will be transferred directly from crane to crane. In fact, in the terms of the geography class, "the new erecting shop will be bounded on the east by the frame shop, on the north by the machine shop, and on the west by the sheet iron shop." The cylinders are to be delivered by the traveling crane in the lean-to, or original erecting shop, so that a more convenient location could hardly be desired. It was to bring about this arrangement of shops, that the 120-ton crane was decided upon in preference to a transfer table. The absence of a transfer table makes available a large area of valuable shop space. The lean-to connected with new shop will also be devoted to jacket, boiler-tube, pipe work and other kindred operations. This shop will be arranged with a flush floor throughout, with the exception of five pits which are thought to be sufficient for all work that can be done most expeditiously with the aid of a pit.

The blacksmith shop is not new, but a drop hammer and furnace have been added, also a hydraulic crane for the frame hammer. Most accurate work is done with drop forgings of all kinds, and the excellence of those which eventually find their way into the interior of a boiler, as part of the staying system, cannot but be mentioned with satisfaction.

The new store house is a model of order and method. There is plenty of room for the material which has to be kept in stock, so that none of it is hidden from view. On one of the upper floors is a test room and laboratory, and a well furnished inspector's room, supplied with a couch and desks.

The shops and grounds are tidy and orderly, no space is uselessly encumbered, and the whole plant has a "ship-shape" appearance which possibly reflects the nautical training of the General Superintendent.

A somewhat humorous commentary on the fact that the Richmond plant is being modernized in all its departments, and that the American Locomotive Company has sanctioned the expenditure of a large sum of money to place it in a position to challenge comparison with any similar establishment in the United States, was found in the fact that on the day when the representative of the *Railroad Gazette* was invited to inspect the plans of the new $100,000 erecting shop, the work on which is being energetically pushed, a local newspaper reporter called, to have the lugubrious "rumor" contradicted, that the whole modern, up-to-date, expanding, busy plant was to be moved away and set down somewhere else, as if it had been an air-ship.

Some Experience with Special Wheels in Heavy Service.

BY P. H. GRIFFIN, *President New York Car Wheel Works.*

After an experience of some years in supplying wheels for service under 50-ton cars and in view of the complaints that have been made regarding the suitability of chilled wheels for such service, we enclose some information on the subject which may possibly interest your readers.

We have now in use and on trial about 30,000 wheels under 50-ton cars on three leading railroad systems. We have designated the different systems by letter in giving the particulars in regard to each.

In furnishing wheels for 50-ton car service, we have always taken the position that the ordinary quality of chilled wheel might not prove suitable and have furnished only wheels of a special quality, this position being taken when we first commenced to manufacture special wheels for this service, on account of the fact that the requirements of such service were unknown and it did not appear that the use of a heavy section in the ordinary quality would meet the great increase in service requirements, especially with reference to flanges, which could not be increased in thickness on account of having to pass through frogs and switches, the openings in which are fixed by M. C. B. standards.

The first important case is that of the railroad designated as "A," to which the first lot of 8,000 special wheels were furnished in 1897. These wheels gave such satisfactory results in service that a further lot of 8,000 wheels of special quality were put under new equipment built for the same company in 1899. This was followed again by an order for 8,000 more special wheels under new equipment built for the same company in 1902.

It has developed since the introduction of the 50-ton cars that the principal cause of failure of chilled wheels under them has been the formation of a series of cracks at the root of the flange next to the tread, these increasing until groups of the same were formed all around the tread, causing the breakage of a part or the whole of the flange, with consequent liability of accident.

Out of 24,000 wheels furnished to the railroad company referred to, the removals on account of seams have been practically nothing. In fact, the service of the entire lot of wheels has been fully as satisfactory as that of any wheels used in lighter service.

The second case, that of the railroad company which we will designate as "B," covers 400 wheels of our special quality which were put under cars of 50-ton capacity in comparison with four other lots of wheels of the same number, of different qualities, three of which consisted of different manufactures of steel wheels. These wheels have now been in service for one year and the removals for seams were 12, notwithstanding the fact that this company has the severest grades and curves of any road in the country. There were no breakages of flanges except in one instance, where a flange was broken in a wreck due to other causes. None of the other removals of the trial lot of wheels occurred except for causes beyond the control of the maker, such as sliding flat, etc. The results from the other makes of wheels included in this test are not known to us, but so far as the test has been made, it certainly demonstrates the fitness of chilled wheels of special quality to answer the requirements of the most severe conditions of 50-ton car service.

The third case, which we will designate as "C," is that of a company to which 500 wheels of a special quality were furnished for trial about one year ago. These wheels were furnished under conditions of test requirements which indicated the special quality of the wheels themselves. This first trial order was followed up about six months after by an order for 3,300 wheels and later by a much larger order of the same class of wheel. This railroad is in a mountainous country having severe and numerous reverse curves. No removals of wheels have been reported from wheels supplied to this company for seams or flange failures, or any removals outside of the ordinary for any other cause.

In addition to these the special quality of chilled wheels have been furnished in smaller quantities to a number of other railroad companies for service under heavy locomotives where the weight exceeds, if anything, the weight per wheel under 50-ton cars, at times running up to nine tons per wheel at speeds of from 35 to 45 miles per hour under heavy freight locomotives.

It would appear from the above results that chilled wheels can be made, with proper experience in manufacture and the use of proper materials, to withstand any service to which they are at present subjected or are likely to be subjected in the future, and it is merely a question of the users of heavy cars and locomotives securing wheels of proper and special quality for the service. The additional price asked for such special quality of wheel over the ordinary is not a very important matter and does not constitute an advance of over 25 per cent. to 33 per cent. over the cost of the ordinary quality of wheel, this slight additional expense being a matter of very slight importance compared with the cost of accidents that have arisen from the breakage of ordinary quality of wheels in heavy service.

As to the cause of flange failures indicated above, some interesting data can be given. There is a difference of opinion as to the cause, but it appears to us to be due to great strain on the flange, either through a blow struck by the flange on the rail in the course of service where a side motion of the cars produces a severe contact of such a character, or running into curves at foot of grades, or under similar conditions. This blow is intensified by the fact that in the ordinary construction of 50-ton cars the load is concentrated over the trucks with the result that the free oscillation of the truck in rounding a curve is prevented and the car runs through the curve with a heavy pressure between the flange and rail, and the whole strain of changing the direction of the truck must fall on the wheel flange, and it naturally follows that in proportion as the load is increased the factor of speed and load forms an increasing total of strain between the flange and rail proportionate to the radius of the curve. This strain tends to separate the crystals of chilled iron from each other and the root of the flange where they are grouped in perpendicular lines in the chilled portion of the tread.

It may be seen on examination of a fracture of a chilled iron car wheel that these crystals of chilled iron group themselves at right angles to the tread. Chilled iron of a proper quality consists of fine crystals which are grouped and mingled together in a manner which gives an increased degree of strength as compared with chilled iron of other qualities where the crystals are differently grouped. It has been the practice of late years to introduce manganese to a considerable extent in the manufacture of chilled car wheels and other castings, this for the reason that the introduction of manganese gives certain chilling qualities to iron which would not otherwise possess it, and to give an increase of strength to the body of the wheel. The effect of the introduction of manganese on the formation of crystals of chilled iron is, to increase the cleavage between the crystals, causing them to have less adhesion to each other and more liability to part under strain. This tendency to separate between crystals of metallic manganese can be readily seen on examination of the metal, and is quite apparent if a piece of the metal is thrown on an iron plate and broken, the result being that the separation of the crystals easily occurs.

It has not been necessary in previous conditions of chilled wheel service to meet this question of the lack of strength or adhesion between the crystals of chilled iron, but it appears to be of vital necessity to do so in wheels made for use under 50-ton cars and the corresponding flange strain mentioned above. The principal quality of chilled iron has always been regarded as its resistance to wear, but it now appears necessary to combine with this quality an additional quality of strength in the chilled metal itself. We have for several years conducted experiments along the line of possible manufactures of this character, and as a result have been able to increase the strength of the flange at least three times over that secured in previous practice of a similar

order with other materials. It necessarily follows that in gaining this increased strength in the flange, an increase in the strength of the wheel as a whole results and we have been able to make wheels without difficulty that would stand a minimum of 10 times the Master Builders' tests.

It does not appear that it would be possible to remedy flange failures in chilled wheels without the use of a special quality of wheel in which material of the necessary quality will be correctly used. No matter what increase may be made in the body of the wheel as a whole, it does not produce an increased strength in the flange. It seems to have been the idea in the case of some railroad companies that a very heavy wheel should be used under 50-ton cars to avoid breakages, but the all important part is that the breakages are occurring in that part of the wheels where no increase in the metal has been or can be made. In some extreme cases of the kind the additional weight of metal used would go very far toward paying the additional cost of procuring the proper metal in a light but sufficiently strong wheel.

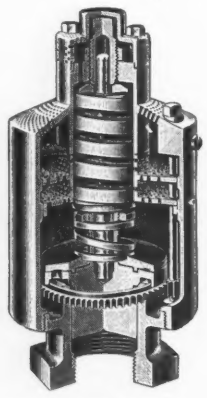
We are more than pleased to find continually increasing interest in the subject of high-grade wheels for all kinds of railroad service, and that much attention is being given to the cost of wheel service from the standpoint of the results obtained as much as from the standpoint of the first cost.

A Self-Adjusting Pop Valve.

Crane Co. has recently put upon the market a new type of self-adjusting pop valves. These valves are constructed on the same general principles as its standard pop safety valves, with the added feature of self adjustment, which is accomplished by means of an auxiliary valve and spring, independent of the main valve and spring and entirely automatic in operation.

The operation of the auxiliary may be explained as follows: As the main valve opens to relieve the overpressure in the boiler, the steam expands into the pop chamber and slightly but continuously opens the auxiliary

No. 428—Open Pop.



No. 430—Muffler Pop.

valve provided with a light spring; thereby relieving the pressure in the pop chamber and causing a gradual and easy lift of the main valve. After the pressure on the boiler is relieved and the main valve begins to close the operation of the auxiliary is just the reverse of opening. It gradually and continuously closes the main valve, holding open throughout the operation sufficiently to release the proper amount of steam from the pop chamber until both the main and auxiliary valve are brought to a tight seat. This tends to do away with all shocks and jars due to quick opening or closing of the main valve and to prevent chattering or hammering, increasing the life of the valve.

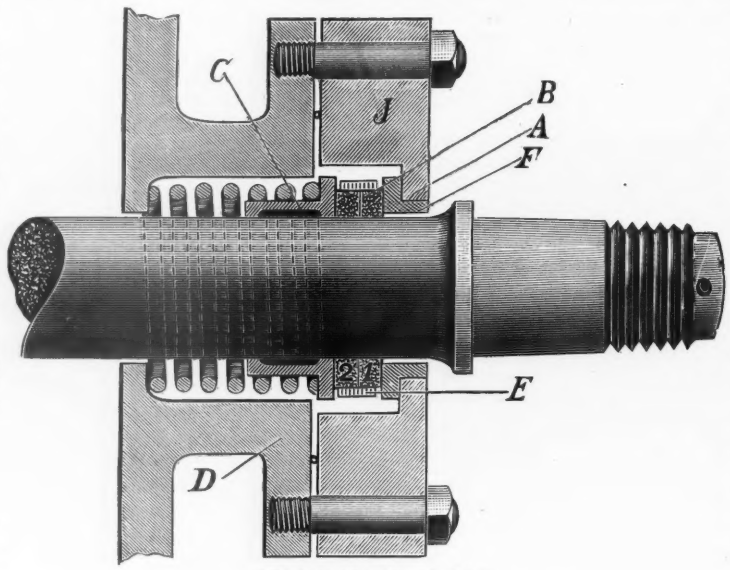
If the valve is set to blow off at 150 lbs. and close at 147 lbs., a waste of 3 lbs., and is subsequently regulated to blow off at a higher pressure, 170 lbs., or a lower pressure, 140 lbs., it will close promptly in either case with a waste of but 3 lbs., without readjustment of the auxiliary.

These valves are also provided with a conveniently located outside pop regulator, which affords additional means for range of adjustment within setting pressures. This is a particularly desirable feature, as the tension on the spring may be changed while the boiler is under pressure.

A New Metallic Packing.

The great difficulty with which metallic packings have to contend is high steam pressures in conjunction with unequally worn piston rods. A packing must not only be able to hold the steam on a newly turned rod, but must be able to pack the worn rod and to adjust itself to the inequalities occurring throughout its length. The effect of metallic packing is to wear the rod and more or less frequent turning is necessary. A packing recently put on the market and said to possess the requirements demanded by the above conditions is known as the Mitchell Packing. It has been on trial on a number of western roads and after tests extending over a year the Union Pacific, Oregon Short Line and Oregon Railway & Navigation Co. have bought the shop right to its manufacture. It has also been put on the Atchison, Topeka & Santa Fe, the Southern Pacific and the Pittsburgh & Lake Erie on trial.

The hardest rod to pack is that having the reinforced cross-head fit and the accompanying engraving shows its application to this form of rod. A is the bushing joint, which is a hammer fit; B the packing segments; C the divided packing follower; D the stuffing-box flange; E the sustaining ring; F the divided gland bushing; J



Mitchell Metallic Packing.

Application to Rod Having Reinforced Cross-Head Fit.

the gland. The packing is made in four semi-circular segments, the rings being placed on the rod with the joints quartering.

It is claimed that this packing can be put on oval worn rods with as good results as though the rod were circular. Also that it will successfully pack rods out of alignment and that the amount of rod wear usually caused by metallic packings is reduced 50 per cent. by its use. It requires no lubrication on high-pressure steam rods other than the oil received from the lubricator. This packing is made by the Paxton-Mitchell Co., Omaha, Neb., and a service guarantee under which it is sold is as follows: Locomotives, compound, 30,000 miles travel; high pressure, simple, 60,000 miles; low pressure, simple, 90,000 miles; stationary engines, 500,000,000 ft. of rod travel.

Railroad Work in Utah and Thereabout—1902.

The Oregon Short Line is said to be having the busiest year in the history of the road. Work is now in progress on the Leamington cut-off, which will be the main track for the Los Angeles line, taking the place of the present line to Provo, Leamington and Tintic. It shortens the distance, reduces the grades and curves and places the Tintic mining district on its main line to Los Angeles. Around the lake a number of very heavy rock cuts have been encountered, the fill at either approach being 30 ft. and the cuts themselves 40 ft. The Utah Construction Co., contractors, has four Vulcan steam shovels at work here. As soon as possible the Short Line will begin laying track below Calientes, Nev., for its Los Angeles line, to connect with the Southern Pacific. The joint surveys with the San Pedro, Los Angeles & Salt Lake, through a portion of Nevada where the two roads parallel each other, have been approved by the directors of both companies. At Pocatello the company is engaged on a $500,000 shop and all over the line new buildings are being erected.

The Rio Grande has no immediate extension work on hand, but is making a number of surveys, the chief one in Utah being for the Salina cut-off. A large amount of work, however, in line changes is to be undertaken at once. Commencing at Mesa, the main line will be lowered for about 7 ft. for a distance of three miles. This work also involves a number of concrete arches over the Jordan River, doing away entirely with bridges and ensuring a solid roadbed all the way through what is known as the Jordan Narrows. The course of the river is being changed in places and here a solid concrete retaining wall will be built. A number of curves will also be straightened.

The Southern Pacific has in prospect the building of the Ogden-Lucin cut-off across the Great Salt Lake, at a cost of about $5,000,000, the present distance being 145½ miles and a saving of 41½ miles being effected by the new line. From the east shore to the promontory, seven miles, the lake is quite shallow, being not over 8 ft. deep, and it is expected that this stretch will be filled in with rock ballast. Curves will be few and very light. The fall from Ogden to the east shore of the lake is 101.7 ft., and the rise from the west shore to Lucin is 512 ft. in 58 miles, thus giving an easy grade. The Utah Construction Co. is now at work on the first section, comprising 14 miles of grade between Ogden and the lake shore. It is thought that two years will suffice for the completion of the work. The Wadsworth cut-off in Nevada is another important piece of work now in progress. This will be 85 miles long and, when completed, will save distance, curvature and gradient. It is the rebuilding, upon straight lines, of the road between Brown's and Reno, Nev., and in the operation Wadsworth will be left off the railroad entirely. The contractors are Corey Bros. & Co. and Kilpatrick Bros. & Collins.

Surveys for the entire length of the San Pedro, Los Angeles & Salt Lake will be completed during June. Materials are arriving at San Pedro for the new railroad wharf, which will be about 700 ft. long, and rails for 400 miles of road have already been delivered. It is estimated that over $2,000,000 has been spent on the roadbed, of which $200,000 went to acquiring right of way between Los Angeles and Riverside, Cal. Active work will begin at the Salt Lake end as soon as the surveys are completed and approved.

Preliminary surveys have also been made for the Eureka & Eastern, showing a maximum grade of less than 2.5 per cent. between Eureka and Redding, Cal., with an extreme altitude of 4,000 ft. Beyond Redding the line reaches an altitude of 5,000 ft. and avoids the necessity for snowsheds. It is proposed to build the Eureka & Eastern to a connection with the Northern Pacific near Boise, Idaho, and also with the Oregon Short Line. This, if built, will serve a population of almost half a million people who are now without direct connection. Very little is known about the ultimate prospects of the company.

Work has also been begun at the Denver end of the new proposed line between Denver and Salt Lake. This line, if built, will be 525 miles long, will cost $20,000,000, and will prove the shortest route between the points named. Mr. D. H. Moffatt, the chief projector, insists that the road is to be built on the lines indicated.

Interlocking at Many Texas Crossings.

The action of the Railroad Commissioners of Texas in prescribing rules for the establishment of interlocking signals at crossings has been heretofore reported in the *Railroad Gazette*. The Commission has now issued an order requiring the construction of suitable interlocked signals at a large number of crossings, and the work must be finished by June 30, 1903. The Commission orders that the expense of construction and installation shall be borne equally by the railroad companies parties to each crossing, and that the expense of operation and maintenance shall be borne in proportion to the number of levers pertaining to each road; but companies may make agreements to divide the latter expense on any other basis. At crossings not affected by this order, railroads must have gates of such design that "if a gate is broken down it can be at once determined which road is at fault." The crossings are described in a Texas paper as follows, and the heading reads "57 crossings"; but nearly every crossing appears to be named twice, so that the actual number must be about 30. The list reads:

Chicago, Rock Island & Texas.—Crossing with Gulf, Colorado & Santa Fe at Saginaw.

Fort Worth & Denver City.—Crossing with Gulf, Colorado & Santa Fe at Saginaw.

Galveston, Harrisburg & San Antonio.—Crossing with Houston & Texas Central at Chaney Junction, with San Antonio & Aransas Pass at Blodgett, with Gulf, Colorado & Santa Fe at Rosenberg, with San Antonio & Aransas Pass at Flatonia, with San Antonio & Aransas Pass at San Antonio.

Gulf, Beaumont & Kansas City.—Crossing with Texas & New Orleans Railroad main line, Sabine Pass Branch and Dallas Branch (three crossings) at Beaumont.

Gulf, Colorado & Santa Fe.—Crossing with Galveston, Harrisburg & San Antonio at Rosenberg, with International & Great Northern at Milano, with Missouri, Kansas & Texas of Texas at Temple, with Texas & Pacific at Fort Worth, with Chicago, Rock Island & Texas and Fort Worth and Denver City at Saginaw, with Houston & Texas Central at Dallas, with Texas & Pacific at Dallas, with Missouri, Kansas & Texas at Dallas.

Houston & Texas Central.—Crossing with Galveston, Harrisburg & San Antonio at Chaney Junction, with Missouri, Kansas & Texas at Eureka, with International & Great Northern at Hearne, with Texas & Pacific at Dallas, with Texas & Pacific at Fort Worth, with Missouri, Kansas & Texas and St. Louis Southwestern at Waco.

International & Great Northern.—Crossing with Texas & New Orleans at Houston, with Houston & Texas Central at Hearne, with Gulf, Colorado & Santa Fe at Milano, with Missouri, Kansas & Texas at Taylor.

Missouri, Kansas & Texas.—Crossing with Houston & Texas Central at Eureka, with International & Great Northern at Taylor, with Gulf, Colorado & Santa Fe at Temple, with Houston & Texas Central at Waco, with Texas & Pacific at Fort Worth, with Gulf, Colorado & Santa Fe at Dallas, with Texas & Pacific at Dallas.

Orange & Northwestern.—Crossing with Texas & New Orleans near Orange.

San Antonio & Aransas Pass.—Crossing with Galveston, Harrisburg & San Antonio at Blodgett, with Galves-

ton, Harrisburg & San Antonio at Flatonia, with Galveston, Harrisburg & San Antonio at San Antonio.

St. Louis Southwestern.—Crossing with Texarkana & Fort Smith at Texarkana, with Texas & Pacific at joint track, with Houston & Texas Central at Waco.

Texarkana & Fort Smith.—Crossing with Texas & Pacific at Texarkana, with St. Louis Southwestern at Texarkana, with Texas & New Orleans near Beaumont.

Texas & New Orleans.—Crossing with International & Great Northern at Houston; with Gulf, Beaumont & Kansas City (three tracks) at Beaumont, with Texarkana & Fort Smith near Beaumont, with Orange & Northwestern near Orange.

Texas & Pacific.—Crossing with Texarkana & Fort Smith at Texarkana, with Gulf, Colorado & Santa Fe at Dallas, with Houston & Texas Central at Dallas, with Missouri, Kansas & Texas at Dallas, with Houston & Texas Central, Gulf, Colorado & Santa Fe, Missouri, Kansas & Texas at Fort Worth, with St. Louis Southwestern at joint track.

The American Machinery Company.

The plant of the American Machinery Co. at Willoughby, O., is being largely added to on account of the increasing business of the company. The buildings are immediately adjoining the tracks of the main line of the Lake Shore & Michigan Southern R. R. and within a short distance of the main line of the Nickel Plate. The tract occupied comprises 10 acres. Extensive additions have been made in the way of new machinery and machine tools of the latest and most improved makes. Electric drives are used for all tools and machinery, making the entire erecting shop thoroughly modern.

The company makes high-grade and up-to-date machines, under United States and foreign patents fully covering the machines and their improvements. Its product includes bolt-heading machines, forging machines, open and solid-die rivet machines, hot-pressed nut machines, nut-tapping and bolt-threading machines, bulldozers and spike machines. These machines are built in all sizes with a capacity ranging from ¼ in. to 6 in. Specially designed machines for up-setting pipe and tubes, with a capacity from smallest size to 15 in. are also made.

The American Bolt Header.

The American bolt-header is shown in the accompanying illustration. Among orders recently received and filled for these bolt headers were the Lake Shore & Michigan Southern R. R., Cleveland; American Car & Foundry Co., Detroit, four machines; American Bridge Co., one each to the Toledo, Detroit, Athens, Pa., Pencoyd and Youngstown, O., works; Vulcanus Forging Co., Cleveland, three machines, and National Malleable Castings Co. for the steel castings plant at Sharon, Pa. Mr. George W. Greenwood, for many years in this line of business, is General Manager of the company.

Timber Production by Railroads.

BY A. REINISCH.

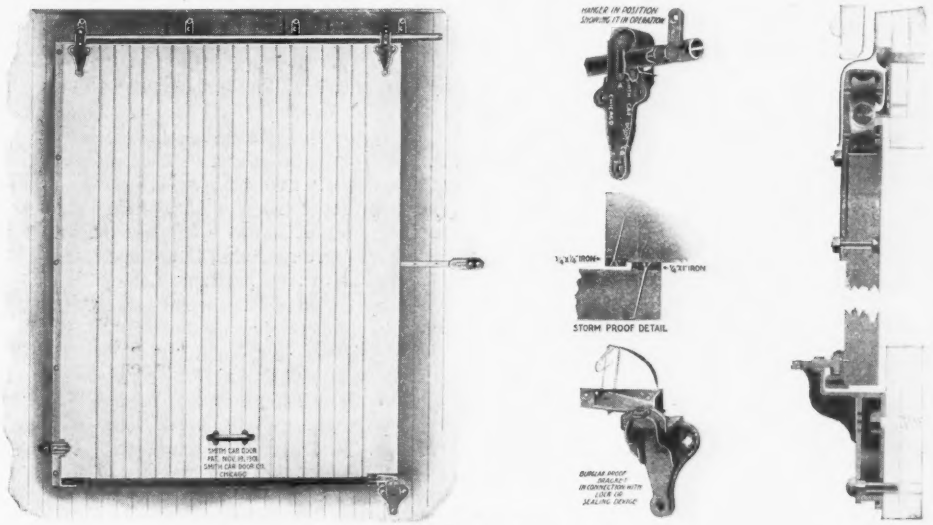
Since the appearance of my first article on "Timber Culture" in the *Railroad Gazette* February 16, 1900, I have received numerous inquiries on the subject, which show the interest railroad men take in timber production. Though all these inquiries have been answered by personal letters, I shall endeavor to touch here the most important points in question:

Using the right of way for planting is out of the question, first, because the expense of cultivating the trees on such a narrow strip would be too great, and second, the material produced would not be straight and clear, but a large proportion knotty and scrubby, as along both edges a strong growth of branches would develop, while in a large square plantation this proportion is materially reduced.

As an instance, in describing the conditions and methods necessary for success let us take the Western Catalpa, Catalpa speciosa. It grows fast, is durable, light, strong, elastic, does not check as much as most other timbers, and is comparatively free from insect foes. The land should be such as will produce good corn or wheat and with a porous subsoil. Prepare the ground by deep plowing and harrow smooth; plant one-year-old seedlings, four feet apart each way (about 2,723 per acre). By carefully planting good stock there will be no loss to speak of in any ordinary season and in a climate like Eastern Kansas. After planting, it is necessary to keep down the weeds and keep the soil loose by judicious cultivating until the trees will keep the land clear by their own shade, which will be in two or three years after planting.

As the trees grow larger they crowd each other and shade off each others branches, starting a straight and clear body. Some will now be noticed to fall behind in size and vigor; these have to be thinned out and this thinning has to be kept up, always taking out the weakest until a portion of them are large enough for posts when the thinning becomes more profitable. The material gained by thinning is of some value, as in eight years after planting the trees will yield excellent fence-posts and up to that time much fuel. In 20 years we will have 800 to 1,000 poles per acre, which will cut 30 ft. long or more.

By starting the scheme on a large enough scale to justify the permanent employment of a competent manager, the cost of the operations will be materially reduced and the successful harvest hastened. These estimates are quite conservative and allow for even a combination of adverse circumstances. How quick trees will grow is shown by the following illustration: Last season, 1901, I planted a lot of black locust. The little plants, none of which exceeded the thickness of an ordinary lead pencil, were received from a nursery stand in town, which had been sold out all but this lot of locust. They looked poor and dried up, the time for successful planting had passed, it was the second week in May and very little was expected of them. They were planted in rows 3½ ft. apart and 2 ft. apart in the rows, by running the spade into the ground the full length of the blade, pulling it to one side far enough to cause an opening in which the plant was inserted. After taking up the spade the soil was firmed by pressing it down around the plant with the feet. Nothing further was done except cultivating, and in spite of the exceptionally dry summer the plants grew to a height of 5 to 7 ft. and covered the ground to an extent that the last plowing was difficult and will be impossible another season.



The Smith Car Door.

Besides the Catalpa there are, of course, other varieties of trees that will make good and durable material for construction. The most important of these are probably among the Evergreens, but in this latitude we had better confine our operations to deciduous trees. They are of quicker growth and generally more hardy from the fact that they have the ability to reduce their radiating surface during their dormant condition, by throwing off their leaves, while the Evergreens are forced to expose all their leaf surface to the drying out effect of the long and changeable winters.

It will no doubt be more difficult to start the timber producing industry than it was to begin the harvest of such a great variety and almost endless quantity of material that nature had saved up in the vast forests of the continent, but the time is at hand when not only railroads but other capital also, will seek timber culture as a safe and profitable investment.

The Smith Car Door.

A car door embodying some novel features is shown in the above engraving. The first of these is the rail, which is a tube $1\,^{5}/_{16}$ in. in diameter and made of 14-gage steel. It is provided with a ⅜-in. slot at the back. The rail supports have two knobs 1½ in. apart, which just fit the inside of the tube, and are joined to the body of the support by a neck passing through the slot in the rail. These supports do away with the regulation furring strip.

Each hanger has two rollers, one above and one below the rail, and which may be seen in the engraving. Each is mounted loosely on its shaft. There is ⅛ in. clearance between the bottom roller and the rail ordinarily, but if the door sticks and efforts to move it cause it to raise up the lower roller comes into play. After the door is once placed on the track it cannot be removed.

A special sealing device in connection with a burglar-proof bracket is another feature of note. When the door is closed the latch, seen at the lower right-hand corner, drops into a shallow slot in the bracket, holding the door securely. The seal may be passed through suitably-provided holes in the latch and bracket. The bracket is secured to the car body by a ⅝ x 4½-in. lag screw. In the shelf of the bracket is a slot through which is dropped a slide, having an enlargement, or head, to hold it in place. This slide covers the head of the lag screw. A carriage bolt passes through the lower part of the slide and bracket and through the side sill of the car. There is only ⅜ in. clearance between the bottom of the door and the bracket, and as some portion of the door is always over the bracket the slide cannot be removed, consequently the lag screw is inaccessible.

The door is made storm-proof by two iron strips, one, ¾ x ¼ in., being nailed to the door post and the other, 1 x ¼ in., is placed on the back of the door. When the door is closed these strips are in contact and overlap.

These doors have a frame 2½ in. thick and weigh over 400 lbs. They are sold by the Jones Car Door Co., Chicago, and will be on exhibition at the Master Car Builders' Convention.

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EDITORIAL ANNOUNCEMENTS.

CONTRIBUTIONS—Subscribers and others will materially assist us in making our news accurate and complete if they will send us early information of events which take place under their observation, such as changes in railroad officers, organizations and changes of companies in their management, particulars as to the business of the letting, progress and completion of contracts for new works or important improvements of old ones, experiments in the construction of roads and machinery and railroads, and suggestions as to its improvement. Discussion of subjects pertaining to ALL DEPARTMENTS *of railroad business by men practically acquainted with them are especially desired. Officers will oblige us by forwarding early copies of notices of meetings, elections, appointments, and especially annual reports, some notice of all of which will be published.*

ADVERTISEMENTS—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay, EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and these only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers, can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially either for money or in consideration of advertising patronage.*

We are able to give in this issue some valuable information on the very important matter of the practicability of the use of cast-iron wheels under 50-ton cars. One of the papers now printed is a specific statement of experience from Mr. Griffin, whose company has achieved a reputation for special wheels for exacting service. The other paper is the result of an inquiry which we have lately caused to be made among those who have been casting and using wheels on a large scale in the severest service. The net results are about what we have long supposed they would be; they indicate that the limit of the use of the chilled cast-iron wheel is still somewhere ahead of the heaviest loads now carried. It is not necessary to stop now to point out the value to the nation, and to the world, of a conclusive demonstration of this fact. That we have many times tried to make plain, and no doubt it is pretty well understood. The time is now come for the demonstration, and that demonstration is in progress. In case "A," cited by Mr. Griffin, the service is as heavy as any in the world; but he says that 24,000 wheels have there given results as satisfactory as any wheels have given in lighter service. Cases "B" and "C" are roads working 50-ton cars on heavy grades with numerous curves. On the whole the information now before us confirms the opinion that with proper materials and design and with correct methods of manufacture the cast-iron wheel may be made adequate for any service now in sight. Those who are especially informed on this subject will be interested to read what Mr. Griffin says about the effect of manganese in promoting the class of fractures which have given especial alarm since cast-iron wheels began to fail under 50-ton cars on grades.

The agreement to interchange freight cars on the per diem basis, after July 1, has been signed by 180 roads out of the 275 members of the American Railway Association; and these 180 own about 1,200,000 cars. As this number represents about four-fifths of all the cars in the country, the strength of the movement is apparent. A year's trial is not only assured, but is assured under circumstances which should strengthen the enthusiasm of all the friends of the movement. Only four prominent roads are now withholding their signatures, though a few have signed with conditions. These conditional signatures, however, are not counted in the total mentioned above. As conditions practically have no standing whatever, it is a little difficult to see what the signers mean by putting them in. However, a signature of that kind may be taken to mean good will, at all events; and with sufficient unanimity of good will, all obstacles can be overcome. We print in another column a circular which has been issued by the Car Service Committee. This circular amplifies the very comprehensive rule which has been prescribed to guide the action of the roads in adjusting local difficulties. For example, the provision for making an allowance to a short intermediate road which does no terminal work, shows with what simplicity the demands of any possible situation can be met. In the example given in the circular it looks as though the short intermediate road, which ought to get rid of most of its cars the same day that it receives them, would get an allowance of money for cars on which it pays out no money whatever. This may not be inequitable, but it seems a little odd on the surface. We understand that meetings to consider local conditions have been held not only at St. Louis, as already reported, but also at Chicago, Cleveland and Cincinnati.

It appears that the leaven is also working in New England. As the reader will recollect, the officers of some of the roads there have given out interviews showing that there is a disposition to start a little campaign of education with consignees. Factories that have been receiving thousands of dollars' worth of car service free must, no doubt, be subjected to some preliminary hammering before they can be made to admit the justice of a demand that they shall pay for such car service at fair rates. The President of the Boston & Maine has given a Boston newspaper a quite full statement of the local situation. We hear that the New Haven road is likely to discontinue participation in through rates on cotton from the West, under certain conditions, unless it can receive from the Western roads some allowance to offset the allowance which it is itself obliged (in the shape of excessive free time for unloading) to make to the cotton mills. Without being able to pass on the merits of a case of this kind, we think we may fairly say that such a proposition is in the right direction, and ought to do good. The question of readjusting the transportation rate to offset the compulsory readjustment in car service rates which is now proposed, must, in the nature of things, be a fundamental issue at many cities, and it will conduce to progress to have the issue squarely met. Whether or not the cotton traffic of New England will afford a typical issue, which can be squarely made, remains to be seen. A good deal of cotton goes east from New York by Sound steamers (most or all of which are owned by the New Haven road), and a good deal goes direct by vessel from southern sea ports to Massachusetts sea ports; so that perhaps the railroads cannot have the whole settlement of the question.

Concerning the Cost of Train Speed.

Among the topics to be reported on at the Saratoga conventions not the least important is that of the cost of running trains fast. There is some danger that consideration of this matter (at least in the discussions) may be diverted from the important to the unimportant. In past discussions the speed of passenger trains has occupied about 90 per cent. of the attention; and yet this is comparatively unimportant, while the speed of freight trains is of immense importance. This is the one point that we wish now to bring out.

Few people would try to dispute the proposition that, a given number of passengers can be carried cheaper slowly than fast. Probably there is now some waste of net revenue in running some passenger trains faster than need be, and money could be saved by agreements not to compete in speed. But, after all, discussion of this phase of the subject is for the present rather academic. It will do some good in leading up to better regulation of speed, and particularly, we should suppose, in helping to stop a great waste of time at stations, which in turn leads to waste of various kinds in picking up the time thrown away. But it is hardly supposable that much can be done in the way of increasing the time taken in passenger runs from end to end. The public will not stand it; in some cases the new and uncontrollable element of electric competition will not permit it; we are not at all sure that it is desirable. After all, railroads exist and are worked for the good of society, and no attempt at economy is rational or can last long if it does not lead finally to the great end of the better service of society. It is essential to test our efforts at reform by this principle, for in the long run it cannot be violated.

If one were to set out to cut down passenger train costs by cutting down speed it might be well to first decide where speed could be reduced with least offence to the patrons of the road, and where it could be raised with advantage to the road, for in the end this is entirely a commercial matter.

To the passenger any practicable increment of speed is important only when it is multiplied by many miles—when he makes a long journey or when he makes frequent short journeys. An increment of speed in suburban service is worth more than in any other service. A man who lives in a suburb and does business in a city travels, say, 10,000 miles a year. The difference between 24 miles an hour and 36 miles an hour, from end to end of the run, is 17½ days a year at 8 hours a day, or 14 days a year at 10 hours a day. If a road carries 1,000 regular commuters and can save to each of them 15 days a year it saves 15,000 working days for some one in one year, or, say, 50 working years. An amusing figure of this sort was obtained from an examination of the passenger statistics of the Manhattan Elevated, from which it was found that if five minutes could be cut off from the trip of each passenger the total time saved in one year would amount to 1,900 years. To put the matter another way, if the man living in the suburbs chooses to spend a certain time in travel, better speed lengthens the radius of the zone in which he may live and the area of land available increases with the square of this radius.

Again, in a journey of 1,000 miles a saving of 18 seconds on a mile is five hours, or a good working day for a man of business. The 20-hour trains between New York and Chicago will be just enough faster than anything now running to enable a man to go back and forth between those towns without losing one business day.

In these cases, then, of suburban trains and long distance trains, a few seconds a mile multiplied by many miles make a product so large that even a small increment of speed per mile becomes really an important matter to the public served. It follows that the pressure of public need will continually force faster service. It follows, too, that in the end the railroads will find profit in faster service, some way; in development of population in the suburbs, or in stimulation of more travel for long distances.

But for middle distances the case is different. The possible time saved on any one journey is not enough to be of much value, and the same individual does not repeat the journey many times a year. In such runs, therefore, the public will probably be longer contented with moderate speed; and then cost of service might sometimes be reduced by slower runs, or at least kept from increasing by faster runs. Even here, however, there are exceptions. For instance, between large cities, like New York and Philadelphia or Chicago and Milwaukee, there is a considerable movement of men whose time is very valuable and there the pressure for fast service must always be great, and there is a chance, at least, of making fast service profitable. Again, the famous Empire State express may be classed among middle distance trains, and yet it is a case where speed has served the public well and has been profitable to the company. It runs too full to be comfortable, but seems to have created a part of its own traffic. The conditions, however, are so peculiar that it is not safe to reason from this train to like trains on other roads. Its great value to the public is not in the quick passage between New York and Buffalo, but in the quick and convenient service of a succession of populous towns.

Finally, it costs more to carry passengers in fast trains than in slow trains; first and principally, because the train must be lighter; also because of delay to other traffic, because more coal must be burnt, maintenance and interest accounts will be greater, and because of two or three other elements. But, commercial and social reasons forbid us to hope for much economy from reduced speeds. No doubt, considerable savings can be made by stopping waste of time in station stops, thus making the schedule with lower maximum speeds.

The great chance for economy appears to be in freight service, and here the great saving may be made because an engine can haul more tons as the speed is reduced. No railroad man needs to be told this; every one has seen it. In 1899 the clear-headed and thorough-going Third Vice-President of the Atchison, then the General Manager of the Northern Pacific, said in his annual report: "The statement is ventured that there is no single reform that can be adopted in connection with railroad operation that will yield so large an increase in net earnings as the adjustment of time of freight trains with reference to the economical performance of motive power. The growing tendency to accelerate the movement of imperishable freight is a useless extravagance and emphasizes the necessity for competing lines to agree with respect to the time of through freight trains."

These words were written after much uncommonly able study by a little group of officers on the Northern Pacific and after great improvements in the road and a revolution in the motive power. We called particular attention to them when the report was published, and again, editorially, a few months

later (1900, page 22). This was followed by some very important discussion which may be found in the 1900 volume of the *Railroad Gazette*, where will be found especially an able and thorough discussion by Mr. McHenry, then Chief Engineer of the Northern Pacific.

Mr. McHenry said: "The principal effect of high speed is the great consequent reduction in the carrying capacity of the train, and the value of this is so many times in excess of all the remaining factors that they may be disregarded without appreciable error." This was illustrated by examples from actual practice, as, for instance, a train of 32 loads at 18 miles an hour was reduced to 7 cars at 35 miles an hour. This is the best summing up of the matter that could be made, but we would advise those who are interested to read Mr. McHenry's statements, which may be found in our issue of March 2, 1900, page 130. Beyond this we need not go now, for we shall shortly have light from the able committee of the Master Mechanics' Association.

The Right to Route Your Freight.

We have now received the full report of the decision of the Interstate Commerce Commission on this subject, which was noticed in our issue of April 25, page 308. The complaint was that of the Southern California Fruit Exchange and others against the Southern Pacific and Atchison roads for refusing to shippers of oranges the right to designate the route over which their fruit shall be carried when shipped to Eastern States. As the reader will recall, the Commission decided that for a railroad to refuse to give bills of lading specifying the route was unlawful. Two or more roads, having established a joint through tariff, must give to all shippers the benefit of it; and it cannot be withdrawn except according to the law, which requires a number of days' notice of changes in rates. To deny a shipper the right to select one of two or more routes is to make a route available for a shipper one minute and not available the next; a route may be open to one shipper and at the same time be closed to another. Chairman Knapp files a dissenting opinion.

The statement of facts, as given in the majority opinion, is summarized below.*

The decision, as given in the opinion of the majority of the Commission, and the reasons therefor, are pretty well set forth in our former article (April 28): so long as the through route exists the rates are guaranteed, by command of the law, to all shippers, and the railroads cannot assume, in consideration of having the privilege of routing, to give a greater guarantee. The law provides for no such thing as a conditional route. "It is a contradiction to say that schedules filed as in these cases create on the one hand many through continuous lines, each and all open at all times to the initial carrier, but none of which is at any time open or available to the shipper except in the varying discretion of such carrier." The Commission believes that the object of the routing was to give effect to the tonnage-division maintained by the eastern connections. "It seems an indefensible proposition that a vital right of the shipper shall be sacrificed and that violation of one important provision of the statute shall be fostered in order to induce obedience to another." Railroads have argued against the formation of through routes by the Government, because they might thereby be forced to make contracts with insolvent connections; but here in this arbitrary routing they are liable to force a shipper to deal with an insolvent carrier. It does not appear that delivery by a particular road at destination has been denied in any particular case, but the possibility of this must be considered. In the Tennessee case *Railroad Gazette*, 1899, page 474) the provisions of the Interstate Commerce law were not discussed.

Chairman Knapp's dissenting opinion is based mainly on the clause in the tariff, notifying shippers that the through rate is conditioned on the road having the privilege to route. "This is in effect a condition upon which the joint through rates are offered, and I perceive no good reason why such a condition may not be lawfully imposed. Connecting carriers are not required to form through routes or establish joint rates. They do so only by voluntary action. They are free to make such arrangements with each other and to discontinue them as and when they see fit. No law compels these privileges to be afforded or prevents their withdrawal. Since through routes and joint rates are wholly in the discretion of the carriers, both as to their establishment and termination, why may they not be offered on the condition that the initial carrier shall control the routing?" The common-law doctrine that a road in contracting beyond its own line may select the connection is quoted by Chairman Knapp from the case of Atchison v. D. & N. O., 110 U. S. 667. Emphasis is placed on the fact that the complainants did not prove, or try to prove, any actual discrimination between shippers. The shipper has the right to stop freight in transit, but not to divert; yet, the majority uses this assumed right to support its decision. Aside from the question of diversion the legitimate value to the shipper of the right to route is not important; but it is important to the railroad, as thereby it has been able to prevent rate cutting of seven years' standing. Routing by the carrier tends, on the whole, to public advantage, as it facilitates through shipments. To deny the carrier the right to route might have the effect of reducing the number of available routes and thus be a disadvantage to the orange shippers.

Thus from the majority decision and the dissenting opinion we get the facts and their bearings with some suggestions of differing points of view; but still we have a decision on only one particular and somewhat peculiar case. The decision settles a case which is of such a nature that only a narrow point is decided. Moreover, the two court decisions, which are cited by Mr. Knapp in support of his opinion, contain important qualifying clauses. In the Tennessee case (Post v. Southern Railway) the court says in substance that the railroad should have the right to route the freight provided there are no good reasons for giving this right to the shipper; and in the Atchison case the court refers to the initial company as a carrier beyond its own line (and thus entitled to special consideration); whereas railroads do not carry beyond their own line, nor do they assume responsibility for the carriage beyond their own line; they only agree as to the price to be charged by the second line and the lines beyond.

Most people would start out with the assumption that the privilege of routing is a common-law right of the shipper. Take a hypothetical case: John Smith owns stock in the Big Four Railroad, which has a line from St. Louis to Cleveland. Smith ships oranges from California to New York, and orders the car sent over the Big Four Railroad. The initial road has made a through rate over the Big Four with or without a condition about reserving the right to change the route. The initial road desires to send the car over the Wabash, and refuses to comply with Smith's wish. Now, the business-like way of making this refusal would be to raise the rate over the Big Four; but the railroad desires to keep in force over the Big Four a rate as low as the Wabash rate for the benefit of other shippers, who are willing to have the road route the freight as it pleases. Is not Smith's wish to send freight over a road of which he is part owner a legitimate one?

The great majority of people who are not lawyers would answer yes; and, moreover, most shippers would advocate legislative compulsion to insure to shippers (in the case we have supposed) rates constantly equal by the Big Four and the Wabash. Judging by the course of legislation in England, and the fact that this idea of compelling railroads to make through routes (at low rates) wherever the public may want them, has often found expression in this country, it seems likely that on a well defined demand, in a case of sufficient importance, Congress would readily exercise the necessary power. It is quite possible, however, that the question may never come before Congress; for American railroads have thus far voluntarily given shippers pretty nearly what they wanted in this direction. As for the present decision it does not yet appear whether or not the Commission will go to the courts to get it enforced; and if it does go, it would be difficult to guess how the court would adjust the inconsistency between a tariff shutting a shipper off from a certain route on a minute's notice, and a law requiring a number of days' notice of any change in rates.

*The through tariffs, showing the rates over 183 different roads, contain a clause expressly stating that in guaranteeing the through rate the road reserves the absolute right to route the freight. Shippers are all the time diverting carloads of oranges to new destinations after they have made a part of their journey. Shippers claim this privilege as a legal right; and to divert to advantage they must know where these cars are while on their way East. Usually the roads route cars as requested.

For seven years previous to 1900 all shippers received rebates of $15 to $25 a car; this was paid by the refrigerator car companies and by the eastern railroads. The California roads claim that their action in routing the freight (beginning Jan. 1, 1900) was necessary to stop this payment of rebates. It appears that the general eastbound tariff of the road, covering all commodities, has the same clause denying shippers the privilege of routing their freight. The Southern Pacific made contracts in 1897 with each of three companies for the use of 1,500 refrigerator cars from each. On these cars, when moving eastward, the owners are to receive 7½ mills a mile; but on the westbound movement they receive nothing except when the car is used as a refrigerator, when a rate of six mills a mile is paid. The charge for icing a car to Chicago is $75, and to New York $90. Only about one fifth of the cars used require ice.

One of the complaints was that Mr. E. T. Earl, President of one of the car companies, could, by his knowledge of the movement of cars, get for his fruit company illegitimate information concerning the movements of cars containing goods shipped by the competitors of the Earl Fruit Company. The Southern Pacific asserted that if this ground of complaint had been known, Mr. Earl's cars would not have been hired.

It was claimed that the roads pool the freight; the Commission finds this charge unproved; but finds that the roads do endeavor to preserve an agreed division of the freight.

The rate on citrus fruits to eastern States is $1.25 per 100 lbs. This figures out, to Chicago 1.128 cents per ton per mile; to New York, 0.799 cents per ton per mile. Adding the icing charges, these averages are increased to 1.388 and 1.020.

The time of transit to New York (originally 25 days) has been reduced to fifteen days, and sometimes to ten.

The Commission ends its statement of facts with the assertion that the facts tend strongly to support the claim that this rate is unjust, but the evidence is not deemed full enough to warrant a positive finding to that effect. The testimony concerning the legality of the icing charge is also deficient.

Annual Reports.

Chicago, Rock Island & Pacific.—The annual report of this company for the fiscal year ending March 31 last, just at hand, covers the operations in the first year of the property, under a new controlling ownership, the so-called Moore interests, of Chicago. The report shows gross and net earnings not only at the highest level ever reached, but gains in the fiscal year in each of these items larger than reported in any previous year. Outside of growing income, the company has had extensive development, in the past year, by plans worked out and still under way. The El Paso extension was completed; the issued stock was increased by $10,000,000, and the authorized issue has been further increased by $15,000,000 to a total of $75,000,000 by action of the shareholders last week, when the limit of indebtedness was also increased to $200,000,000. An extension to St. Louis was undertaken, and the Choctaw, Oklahoma & Gulf was acquired. At the annual meeting the stockholders authorized the consolidation with the main lines of the leased Rock Island & Peoria and the Burlington, Cedar Rapids & Northern, heretofore separately operated, though the Rock Island had long held the controlling interest. All these matters, however, receive scant or no reference in the annual report. That is chiefly a record of earnings and traffic, and makes a satisfactory record in these respects, despite heavy losses in very important traffic.

With 2,840 miles (out of the 3,910 miles of operated line) in the States of Kansas, Nebraska, Missouri and Iowa, all more or less affected by last year's shortage of corn, the revenue records for the 1902 fiscal year covering practically all the months in which the effect of this shortage should have been specially felt, show increase in gross receipts of $3,021,150, or 11.9 per cent., as against increases of $2,714,090, or 11.98 per cent., in 1901, and of $1,982,690, or 9.59 per cent., in 1900. The enlargement of net revenues last year was even more noteworthy as compared with previous years, than in gross. It ran up to $1,932,000 compared with a gain of $531,000 in 1901, and of $677,000 in 1900. This large relative gain in net was in part due to maintenance charges being kept down, whereas in the immediately previous years these were considerably enlarged. The factors governing the increase in gross were also different in significant particulars from those of previous years.

Increased mileage of road operated has not materially affected changes in gross earnings in recent years, and this had less effect last year apparently than in previous years. The annual report, however, raises a curious point in this particular. It itemizes the length of road operated, but nowhere gives the average miles worked. The total was 3,910 miles on March 31 last as against 3,819 miles in 1901, and 3,647 miles in 1900. In the text of the report, however, it is pointed out that a new line of 65 miles in Oklahoma Territory, noted as completed, is not carried in the table of mileage because not a portion of the company's owned line, although it is stated that the earnings and expenses are included in the income account.

The distinctive feature of the income account seems to be the gain in passenger revenues, which ran up to $1,630,000, or 25½ per cent. for the year, as against an increase of $1,331,500, or 7½ per cent. in freight revenues. This increase in passenger revenues compares with a gain of $859,000, or 15½ per cent. in 1901, and of $487,455, or 9⅔ per cent. in 1900. As in each of these earlier years, the heaviest proportion of enhancement in passenger revenues was from local business. In the freight department, however, the chief proportion of the gains was in through business. The division of the revenues and net earnings after taxes for each of the last six years are shown below:

	Passenger earnings.	Freight earnings.	Gross earnings.	Net earnings.
1902	$8,030,164	$19,061,857	$28,385,846	$10,131,121
1901	6,400,014	17,730,398	25,364,695	8,199,602
1900	5,541,037	15,581,092	22,650,605	7,668,154
1899	5,053,581	14,351,656	20,667,915	6,991,804
1898	4,316,817	13,835,995	19,584,584	6,952,618
1897	4,072,127	11,229,175	17,146,653	5,533,825

A significant fact in the freight traffic and revenues of 1902 is the increase in average ton-mile revenue which accounts for much the larger share of the total gain recorded, or for approximately $920,000, leaving about $411,000 as revenue accruing from the larger business done in the past year. The ton-mile rate which has been reported unchanged at 9.9 mills for three years past, is given as 1.04 cents for 1902. This change in the ton-mile revenue seems accounted for by the changes in traffic, which are of considerable interest. There was very large loss in corn and in other grains and agricultural products, while most other items of traffic increased largely. In corn the loss was about 36 per cent. Increase in cattle, dressed meat and other like business may also

be attributed to the same circumstance. Farmers rushed cattle to market because of the high prices of feeding last winter.

The increase in total tonnage was about 7 per cent., and the increase in ton mileage was less than 2¾ per cent. The aggregate increase was 50,035,000 ton-miles.

The irregularity and change in the character of business probably explain the relatively heavy increase in "conducting transportation" expenses in 1902. This increase was $1,106,000, nearly 14 per cent. above the 1901 charges on this account. The changes in the several departments of expenses for a series of years past are shown below:

	Conducting transp.	Main. way.	Main.eq.	Oper. exp. and taxes
1902	$9,161,479	$4,646,172	$2,908,732	$18,254,725
1901	8,055,311	4,597,294	2,981,190	17,165,093
1900	7,263,183	3,875,448	2,353,778	14,982,451
1899	6,732,489	3,251,590	2,037,895	13,676,111

These changes may be examined in connection with the following record of traffic and train movement:

	Ton-miles.	Passenger miles.	Freight train miles.	Pass. train miles.
1902	1,839,127,300	372,313,683	10,348,780	7,569,872
1901	1,789,092,500	295,952,782	9,850,204	6,931,145
1900	1,605,226,700	259,662,994	9,058,917	6,343,838
1899	1,452,386,500	240,826,469	8,365,560	6,198,769
1898	1,421,433,900	196,837,343	8,387,650	5,588,191
1897	1,175,517,800	178,084,817	7,437,841	5,504,629

The text of the report gives a brief account of the El Paso extension of which, however, only the 56 miles, from Liberal, Kansas, the starting point, to the Texas State line, 56 miles, is carried into the company's account. The remaining sections to El Paso are owned and operated by separate corporations. President Leeds notes total charges to capitalization of $3,375,556, of which $936,150 is for extension work, $1,437,400 for new equipment, and $456,900 for second track work. This latter comprises about 34 miles in Iowa. In addition, 29 miles of second track were built. The new equipment bought comprised 67 locomotives, 1,852 freight cars and 38 passenger service cars, of which the cost of 30 locomotives, 1,300 freight cars and 28 cars were charged to capital, and the balance against operating expenses.

Changes in capital account were important. The $10,000,000 new stock authorized at the annual meeting of 1901 is taken into the accounts. No formal explanation is made of the uses of the proceeds, though it is generally known that the stock was sold to complete the El Paso extension. An issue of $3,000,000 bonds was also made, but nothing is said as to its application. The El Paso extension work is represented by advances of $3,814,027. Increase in bills payable from $1,911,900 in 1901 to $3,032,540 in 1902 may also be on account of the same work, but there is no statement in the report to clear up the point. "Cash and cash assets" are carried at $17,880,854 in the balance sheet, as against $7,358,995 a year ago, and the profit and loss surplus credit is $13,563,838. The financial exhibit presented is as satisfactory as the statement of income which follows, and indicates a surplus of over 12 per cent. on the $60,000,000 capital stock now outstanding.

	1902.	1901.	1900.
Gross earnings	$28,385,846	$25,364,695	$22,650,605
Net earnings	10,131,121	8,199,602	7,668,154
Other income	948,848	701,379	701,440
Total income	$11,079,969	$8,900,981	$8,369,594
Bond interest	2,951,322	2,911,980	3,055,313
Rentals	907,705	891,984	852,419
Total charges	$3,859,027	$3,803,964	$3,907,732
Dividends	2,247,901	1,999,692	1,999,586
Surplus	$4,973,041	$3,097,325	$2,462,475

In these years 5 per cent. has been paid in dividends to shareholders, but only 4 per cent. has been charged against income accounts, the balance of 1 per cent. being chargeable on the $50,000,000 stock formerly outstanding against improvement account. The dividends payable in 1902 on the increased $10,000,000 stock were charged in the full 5 per cent. rate against income, but only on this new stock.

The State of Ohio has passed a law requiring, on every road that runs more than four freight trains a day, a full crew of five men, including at least two brakemen, on every through freight train; and an engine without cars must have a conductor or flagman if it runs more than 25 miles. A railroad officer violating this law is guilty of a misdemeanor and is subject to $25 fine. It would appear that the railroads of Ohio, if they wish to know what the law really requires of them, ought to wait until the end of the Legislative Session, for this law regulating freight train crews, passed May 10, seems to be a substitute for one passed eight days earlier, which referred to passenger trains alone, no mention of freights being made. Possibly this statement will be nullified by some new action before it reaches the reader. One of the bits of wisdom recently proposed before the Ohio legislators was a bill prohibiting railroads from refusing employment to persons over 35 years old. Strange to relate, the members rejected it. The hypnotizer employed by "labor" must have been absent that day.

The Publicity Department of the Louisiana Purchase Exposition issues an illustrated periodical paper designed to set before the people the attractions of that enterprise. In the last issue that has reached us are a number of pictures showing Mr. Santos-Dumont, and various officials of the exhibition, posed in more or less striking groups, and engaged in "selecting a route for air-ship races." Probably it is necessary to do more or less circus work to attract crowds to such an exhibition, but it seems to detract somewhat from the dignity and solidity of the enterprise to use as an attraction such a fake as this so-called "air-ship." Despatches from the other side of the water tell us that Mr. Santos-Dumont's air-ship has been cut to pieces in a warehouse, in some mysterious way. This, we take it, is a variation of the device of the theft of the diamonds of an actress.

NEW PUBLICATIONS.

Transactions of the Association of Civil Engineers of Cornell University. 1902. To be had of Professor C. L. Crandall, Lincoln Hall, Ithaca, N. Y.

This annual number is a pamphlet of 136 pages, with numerous illustrations. The contents are principally lectures and papers by non-residents and by graduates. The topics covered embrace Railroad Management, Concrete Sewer Construction, A Railroad Tunnel, The Design and Care of Railroad Bridges, The Drainage of New Orleans, Surveys for an Isthmian Canal, and Anti-Friction Bearings.

A Mechanical Index.—The Industrial Press, 9 and 15 Murray street, New York City, has begun the publication of a series of volumes designed as an index to machine tools, woodworking machinery, electric and steam appliances, etc. In due course, the volumes now issued in sections will be assembled in one volume of about 600 pages. The object of sending out the work first in sections is principally to get corrections before publishing in more permanent form. Section A, now published, comprises machine tools, metal working machinery, machinists small tools, etc. It gives first a general index in English, German and Spanish. This is arranged alphabetically by the English names, and opposite each name is a number. For instance, the first entry is "Adjustable Inclinable Presses—445." The next division is an alphabetical list of the manufacturers of the various articles, giving simply firm names and addresses. This is followed by a classified list, which is divided into bicycle machinery, blacksmiths' tools, bolt and nut machinery, machine tools, etc. Here, the serial numbers are placed in order, before each title, and following each title are the names of the manufacturers. For instance, referring to No. 445, which has already been cited, we find "Adjustable Inclinable [Presses] which can be quickly and easily adjusted to upright and inclinable position"; and this is followed by ten firm names with addresses. It will be seen that the scheme works out in convenient form for quick reference, and we should suppose that the lists would be very useful. The price of Section A is $1.00.

TRADE CATALOGUES.

Dry Kilns.—Some observations on the theory of lumber drying are to be found in the pages of the American Blower Company's catalogue No. 139, on Dry Kilns, which has just been issued. The operation of the "A. B.C." moist air dry kiln is described and its operation outlined briefly. Separate details follow with more explicit references. The "A B C" hot-blast apparatus is presented to the reader in the same way. Dry kiln appurtenances are illustrated and explained. The catalogue closes with illustrations, facts and figures of dry kilns already installed in various manufacturing establishments. The half-tones in the book are clear, and the information given about each appliance is useful. The American Blower Co. of Detroit, Mich., and 141 Broadway, New York, will furnish this catalogue upon application.

Link-Belt Engineering.—The catalogue of the Link-Belt Engineering Company of Nicetown, Philadelphia, has just been issued. Two perspective views of the company's works at Nicetown and Chicago are given in the opening pages. The catalogue of 319 pages is explained in the words of the preface, it is "a story of achievement told by photographs of plants, installations and machines, with a record of inventions, improvements and refinements of detail, to which are added some tabulated memoranda for the engineer, and the prices of listed elements." The numerous half-tones are nearly always self-explanatory, but where some description is required it is given. A useful table on the properties of Manila ropes is given, for the guidance of those who desire information concerning the transmission of power by ropes. Under the head of chains, details are given of Ewart detachable link belting, the monobar, the Dodge chain, and all the other varieties manufactured by this concern.

Ventilating Fans.—The American Blower Co.'s catalogue No. 140 on disc ventilating fans, contains information respecting this particular product of the company's shops. The A B C fan is attached in the center to two large discs, one on either side. The object of this is, when delivering air into a long pipe or conduit against pressure there shall be no air go back through the center of the fan. This may seem extraordinary but the speed at the outside of the blades is high, and the propulsive force great, but as the center is gradually approached, both these factors rapidly decrease, until at the hub there is no force whatever, the result being that after a certain pressure has been established in the pipe, any additional speed will simply bring air back through the center of the fan. It is to do away with this defect, in fan operation, that the A B C fan has been devised. The various forms of fans, bearings, driving apparatus, etc., are explained by the use of half-tones and drawings, and also in the letter press. Sizes, speeds and prices are given, together with tables of dimensions for ordering. Several other tables such as the horse-power of a leather belt 1 in. wide, and the properties of saturated steam are given. The American Blower Co.'s shops are at Detroit, Mich., but the New York office is 141 Broadway.

Dayton Draft Gear.—The Dayton Malleable Iron Company has recently issued Catalogue No. 2, which contains a history of the Dayton draft gear and illustrations and descriptions of the device as recommended for application to cars of various types and capacities. The pamphlet also contains an interesting report of some tests of this gear made at Purdue University last year.

Mitchell Packing.—The Paxton-Mitchell Co., Omaha, Neb., have sent out a pamphlet describing the Mitchell Metallic Packing, for which they claim a number of points of superiority over the ordinary metallic packings.

The Elliott Electric Blue Print Co., Pittsburgh, Pa., has issued a circular descriptive of the Elliott system of blue-printing by electric light. The apparatus was described and illustrated in our issue of Feb. 21, 1902, page 128. It will be recalled that the machine is cylindrical in form.

Structure and Finishing Temperature of Steel Rails.*

It is well-known that when a piece of steel is allowed to cool undisturbedly from a high temperature, it crystallizes, and that the resulting crystals or grains, as they are frequently called, are the larger, the higher the initial temperature and the slower the cooling. This was first forcibly stated by Professor Tschernoff in his masterly paper on "The Manufacture of Steel and the Mode of Working It," communicated to the Russian Technical Society in April and May, 1868.

It is also well known that if the steel be vigorously worked (rolled or forged) while it is cooling from a high temperature, crystallization is prevented, but as soon as work ceases, crystallization sets in until a certain temperature is reached, which in the majority of cases is not far from 700 deg. C., and below which there is no further growth of crystals. If work be performed below that critical temperature the crystals are permanently distorted, being flattened and elongated in the direction of the rolling and this distortion of the crystals is greater the lower the temperature at which the work is carried on. Such distortion causes a decrease of ductility and, eventually, brittleness, a striking illustration of which is found in the drawing of wire, which must be frequently annealed to remove the brittleness produced by work at a low temperature. The annealing removes the distortion of the crystals and, therefore, the resulting brittleness by causing the metal to assume a new and finer crystallization.

We may, for convenience, call the range of temperature during which steel crystallizes, and which extends from the melting point to the critical temperature (about 700 deg. C. in the case of carbon steel), the crystallizing range, and the work performed at these temperatures *hot work*, while the work done below these temperatures will be called *cold work*.

Hot work influences the final structure by preventing or retarding crystallization, while cold work distorts the crystals.

It follows from the above considerations that in working steel, as is done in the manufacture of so many implements, from a high to a much lower temperature, crystallization is retarded, *i. e.*, is made up to cover a much shorter range of temperature, extending from the *finishing temperature* (*i. e.*, the temperature at which work ceases) to the critical temperature. The resulting structure will, therefore, be finer grained, *i. e.*, will be made up of smaller crystals, than if the metal had been allowed to cool *undisturbedly* from a high temperature: the crystals will be the smaller the lower the finishing temperature. Should work be continued below the critical temperature the crystals will be distorted, which implies a loss of ductility.

It has been conclusively shown that the finer the structure, *i. e.*, the smaller the crystals, the more ductile will be the steel, and since ductility is always a very desirable property, whatever the intended use of the finished implement, we should so conduct our treatment of the metal as to confer upon it the finest possible structure. The importance of finishing steel implements at the proper temperature, therefore, need not be insisted upon. It is now appreciated by all enlightened metallurgists.

The manufacturers of steel rails have, more than any other producers of finished steel articles, given careful attention to the important influence of the finishing temperature upon the structure and the physical properties of their rails. In these days when the tendency is to allow more and more carbon in rail steel, in order to lengthen the life of the rail, the importance of securing all the ductility possible from the heat treatment stands pre-eminently at the front.

The importance of low finishing temperatures was clearly brought out some 10 years ago at the South Chicago works of the Illinois Steel Company, through some extensive tests conducted by the writer, the results of which were summed up in a paper presented at the Engineering Congress in 1893. In spite of the conclusiveness

*A paper by Albert Sauveur presented for discussion of the International Association for Testing Materials, American Section, at the fifth Annual Meeting, Friday, June 13, 1902.

of these tests, however, the management could not be made to take up any efficient measure toward lowering the generally too high finishing temperature of the rails. It was assumed that any step in that direction would interfere with the output and this was not to be considered. While the results given in the paper did not attract much attention at the time, a seed had been sown that was destined to bear much fruit. The importance of proper finishing temperatures gradually asserted itself until at the present day there is hardly a steel rail user or producer who is not fully alive to it. The results of many experiments along this line have been published within the last 12 months, which, although they merely confirm the conclusions reached some 10 years ago, are, curiously enough, treated by their authors as newly discovered facts. This peculiar attitude on the part of writers who ought to be familiar with the previous treatment of their subject, attracted the attention of the *Railroad Gazette*, which says editorially, under date of May 31, 1901:

In all the discussions on the heat treatment of steel the matter has been treated as though it was new, and the writers appear to have forgotten the early work of Tschernoff, Metcalf and others, and the later work in the early 90's. It is well to realize thoroughly that this is no new fad. Notwithstanding all that has been said on this subject is has been a hard matter to get engineers to realize that steel can be rendered almost worthless by being finished too hot. When this important fact is fully appreciated we may expect to get the best results from steel, as means will be taken to give it the proper heat treatment in rolling.

In Mr. Metcalf's classical paper on steel, presented before the American Society of Civil Engineers, March 2, 1887, and reprinted in the *Railroad Gazette* of March 18, he says: "As steel congeals it forms crystals and the sizes are largely affected by the rate of cooling; slow cooling favoring the formation of large crystals, quick cooling and also agitation producing fine crystals. . . . In every piece of steel that is in existence to-day there is a sure record of the last temperature to which it was subjected as well as of the manner in which the steel was worked. I mean to say that for every variation of heat that is visible to the naked eye there is a corresponding variation in structure which is equally visible to the naked eye if the record be opened by fracturing the piece. . . . For a double quantity of carbon we have five times the difference in specific gravity, due to an equal difference in temperature. . . . The finest crystals and the best structure can only be formed by quick cooling and the violent agitation of the hammer or of the rolls."

At the World's Fair Congress of Engineers, in Chicago, Mr. Albert Sauveur, then in the employ of the Illinois Steel Company, gave the results of his investigation on the heat treatment of steel rails in six propositions, which are well worth the study of any one interested in this subject. His paper will be found in the *Transactions* of the Institute of Mining Engineers, Vol. XXII., from which we quote:

"A polished and etched section of steel rail when examined under the microscope does not by any means reveal in all its parts the same structure. This heterogeneousness of structure is due to the different temperatures at which the various parts of the rail leave the finishing rolls, and to the unequal rate of their subsequent cooling. The propositions formulated in the first part of this paper should enable us to foretell such variations in the structure of a rail.

"The outside of a rail, leaving the rolls coldest and cooling quickest, will offer less chance for crystallization, and should therefore show a smaller grain than the inside, which, being the hottest and cooling down more slowly, will favor the crystallization of the metal, the size of the crystals or grains reaching its maximum in the center of the head. It might also be inferred that the smallest grain will be found at the extremities of the flange, since this is always the coldest-finished region. Proceeding from the outside to the inside we shall find the tendency toward coarse crystallization gradually increasing."

The Kennedy-Morrison Rail Finishing Process.—The suddenly renewed interest in the subject of proper finishing temperature for steel rails, just alluded to, led the Carnegie Steel Company to a notable departure at their Edgar Thomson plant, from the ordinary mode of proceeding. . . .

Let us look critically into this new departure in rail rolling. The rail when it reaches the cooling table introduced before the final pass is at a high, or relatively high, temperature and is then allowed to cool until a certain lower temperature is attained. During this undisturbed cooling the metal evidently crystallizes and the rail must necessarily enter the finishing rolls in a crystalline condition, which will be the more pronounced the higher the temperature of the rail when it reached the cooling table and the slower and more prolonged the subsequent *undisturbed* cooling. It also seems as if the single pass to which the metal is subjected after this crystallizing period cannot be sufficient to break up the crystallization just created. On theoretical grounds, therefore, if a material gain results from this method of proceeding, I do not see how it can be accounted for. Let us remember that any *undisturbed* cooling above the critical temperature constitutes a crystallizing period. By partially cooling the rail before the final pass, we shorten the crystallizing range after the rail has left the finishing rolls, but we create a crystallizing period just before the final pass, which is exactly equal in length to the diminution of the final undisturbed cooling. We do not, by so doing, decrease the *total* crystallizing range, which alone governs the size of the final crystals; we merely divide it, causing a part of it to be located immediately before the final pass and the balance immediately after, so that a rail treated by this process has passed through a crystallizing period of *exactly the same length*.

The only beneficial effect, therefore, that can be claimed for this process is that it breaks up the crystals produced just before the last pass, resulting in a finer structure rail. If we consider that the reduction produced by the last pass is about 5 per cent. it seems hardly conceivable that so slight an amount of work could be effective in breaking a pre-existing coarse structure.

Similar criticisms of the value of the Kennedy-Morrison process have been published by Mr. S. S. Martin, of the Maryland Steel Company, who contends, apparently on good ground, that any undisturbed cooling introduced in the process of rolling, in order to be effective in producing a finer grained rail, must take place at an early period, because then the considerable reduction, *i. e.*, the great amount of work to which the rail is subsequently subjected, will break up the crystals formed during that undisturbed cooling. It has also been argued, and rightly, I think, that those mills which do not reheat their blooms produce finer grained rails, for the simple reason that they finish their rails at a lower temperature.

To sum up, in order to confer a fine-grained structure upon steel rails, three courses seem to be opened:

1. To shorten the crystallizing period, *i. e.*, the time during which the rail is allowed to cool undisturbedly above the critical temperature (say about 700 deg. C.). In other words, the rail should be finished sufficiently cooled, and the finishing temperature will, of course, depend in turn upon the temperature of the ingot when rolling begins and upon the speed of the operations. The main objection to starting and carrying the rolling at a relatively low temperature is that it throws more work upon the rolls. The objection to a slow rolling speed and handling of the material is that it decreases the output of the mill. Both objections imply an increase in the cost of the rail.

2. To cause a part of the crystallizing period to occur previous to the final pass, *i. e.*, to allow the rail to cool undisturbedly at some stage of the operations, and for a short time, before completing the rolling. This cooling in order to be effective should occur at a sufficiently early stage of the rolling, in order that the resulting crystallization may be broken up through a sufficient amount of subsequent work and reduction. Such results would be obtained by placing the cooling table at the shears. The objection to this course is that the shaping of this cooler bloom into rails would require greater mechanical effort and, therefore, increase the cost of production.

3. To finish the rail at the temperature most desirable for easiness and speed of manipulation in rolling and then to reheat it to a temperature slightly above the critical temperature, a treatment which would result in the breaking up of the pre-existing coarse structure, replacing it by a much finer one. This course would undoubtedly be the most effective of the three as it would not only impart a fine structure to the rail, but also a *uniform* structure to all its parts, while a rail not so treated must necessarily be coarser in the central parts than nearer the cooling surfaces, owing to the higher temperature of the center when the rail leaves the finishing rolls and to its slower subsequent cooling. The cost of such reheating treatment would undoubtedly be very great and, possibly, prohibitive.

The Railroad Telephone.

BY C. A. HAMMOND.

We have now had the telephone for a quarter of a century. The original patents have expired, and, though the Bell Company, fostered by the monopoly and strengthened by additional patented improvements, still holds a commanding position in the business, the great invention is, in its essentials, public property. Its use has wonderfully increased, and it is now one of the necessary factors of our modern life. In a very well written article in the first issue of the *Railroad Gazette* for 1901, it was pointed out that the telephone is fully adapted to train despatching. Editorial comment brought out a rejoinder from an official of a leading trunk line, demurring to the conclusions reached, and betraying the usual skepticism as to the advantage and reliability of the telephone as compared with the telegraph for the conveyance of train orders. . . . A paper on the "Telephone in Railroad Service," by Mr. Valentine, showed how, by its means, a multitude of officials and employees, separated by space, are brought together, and their capacity increased ten-fold. On the heels of this came a brief description of a very thoroughgoing, up-to-date installation of a telephone system, with double copper wires, on the lines of the Delaware, Lackawanna & Western. Finally, we had from the Pacific Coast Railway Club an interesting discussion on the question, "Can the Telephone Be Safely Used for Despatching Trains?" The replies of a signal engineer, an assistant superintendent, and a train despatcher were all in the affirmative, qualified somewhat as to its use in certain cases. . . .

Why use a complex and artificial method of communication when a simpler and more direct can be employed? What is simpler or more natural than to call an employee into your presence, dictate to him an order, which he writes out and reads over to you, and receives your "O. K." sanction? This, a good telephonic apparatus virtually does. You call your operator; he may be a mile away, or a hundred; it's all the same to you when his voice sounds in your ear, and he is practically in your immediate presence while the conversation lasts. You are both intelligent enough to appreciate the value of a systematic method, and to submit to good discipline and rules. You invariably read to him, per telephone, your printed or written order, numbered and dated; he invariably writes down the order from your dictation, or fills in the proper blanks in his forms (a duplicate of yours) as you direct; he numbers and dates the order, and attaches your signature to it, as so instructed; he then reads it over carefully to you, word for word, per telephone, awaits your "O. K." or "Complete," writes it on the order, with the exact time added, and certifies to your said approval over his own signature. He then delivers the order to the person addressed, with manifold copies to other employees equally concerned, and takes their signed receipt that they have received, read and understood the order so delivered. This receipt he forwards to you (keeping his own copy) and the transmitted order also is returned to you by the employees receiving it, and you compare the same with your own copy of the original order, which you have read, per telephone, to the operator in the first place.

Such a method the writer used for many years, with success and satisfaction, and though differing slightly from the procedure under the Standard Code, it worked well; and of the thousands of orders so issued, there was scarcely a single error, and never any mistake in the essential particulars, although occasionally an "operator" would be encountered who had had, perhaps, little experience either in railroad work or with the telephone; but he *was* trained to do precisely as he was told, and to obey the rules. The discipline was rigid and severe, not less so with the sender than the receiver. The rules for transmission of telephone orders were fully and minutely set forth, and numbered, in the Book of Rules; if, in the handling of the telephone, or in the process of taking down an order, numbering, dating or signing it, repeating it back, getting "O. K.," etc., the "operator" betrayed any carelessness or ignorance of the rules applicable to the case in hand, he was brought to book instanter, referred to the rule he was careless of, reprimanded or admonished, and made to proceed, step by step, in the path marked out for him, all the while the conductor, perhaps, might be waiting at his elbow for the necessary order allowing him to proceed. But these cases were exceptional: as a rule, the employees took a commendable interest in their work, and the system followed was equal to any emergency.

There never was the least trouble with the transmission of the words of the order, including number, address and time, even though the line worked poorly, and at first more or less induction was present, though afterward with improved metallic circuits, the latter annoyance was almost wholly eliminated. Still, "O. K." has been unhesitatingly given, even to the faintest whispered repetition, when it was clearly perceived that it was perfect, even though the closest attention of the whole mind was necessary to be sure of it. Of course, if the line failed before "O. K." could be sent, those two momentous letters could not be written on the order by the operator or agent, and it was marked "void," and so forwarded to the despatching office in the next morning's returns. The operator was required to reply "Good day" to the sender's "Good day," before hanging up the telephone.

Given, therefore, a perfect medium for the transmission of spoken words to any reasonable distance, the main thing necessary to good service is to insure accuracy and care in the process of transmitting and recording the message, and to fix beyond question the responsibility of all parties concerned; these are three—the sender, the receiver, the executor. The despatcher's responsibility is two-fold: To prepare a safe and proper order, adequate to the case in hand, and to be sure he gets a perfect repetition back to him before he authorizes "O. K." or "Complete." The receiving agent's responsibility is, first, to repeat the telephoned message by reading the exact words as he has written them; second, not to affix the "O. K." or "Complete" until he has clearly heard it from the despatcher, then certifying the fact over his own signature, and, third, to make correct and seasonable delivery to the executor, and obtain from him his signature acknowledging the receipt of the order and that he has read and fully understands it.

An important advantage of the telephone is the ease with which a situation can be quickly reported, preliminary to issuing an order, and in explanation of the case requiring it, and other items of information that can be brought out by a quickly spoken conversation, with five times the speed of a telegraphic colloquy, while bringing the parties personally into touch with each other, almost as if they were in the same room together. This, of course, applies more especially to cases where trains are reported by their conductor, direct, who, then, in taking a train order, acts as the receiving agent, also getting his receipt from his engineer, to whom his order is addressed. This would require that trainmen, as well as station agents, should be thoroughly conversant with the rules for transmission of train orders by telephone, which, however, involve no more difficulty than those pertaining to their other duties.

Though the writer used a "single-order" system, there is no reason whatever why the telephone should not be equally available for the double-order method, with no less advantage, and perhaps with less disadvantage than by telegraph. By having a series of printed forms, like those set forth in the Standard Code of Rules, for the different kinds of train-orders, the despatcher simply calls to the operator to use form No. ——, and then reads his order, stopping long enough at each blank for the receiver to properly fill it in, and then the whole order is repeated from the beginning, with all the printed and

written words in regular course. This would save much time and insure greater accuracy.

On the whole, we must conclude that the telegraph retains its hold on account of cheapness, wider distribution of its wires, disinclination of officials to get out of the ruts, and a preference for methods to which they have become accustomed; but that the telephone, properly installed and properly used, is intrinsically the better instrument, more useful in a variety of ways, more flexible, and, if a good method is followed, a time-saver as well; and time is not merely money—it is life. But there are incidental advantages in a telephone system, which may often prove of the highest importance. It takes a bright young person scarcely less than a year to learn the Morse sounder, while he, or anyone, learns the telephone in five minutes. Thus, an intelligent conductor can report his own train wherever he can find the connecting instruments, and, if necessary, take a train order to himself and engineman—why not? Or, as has doubtless occurred to anyone thinking of the subject, with the extra set of instruments, forming a part of his train equipment, he can, in case of unusual delay, wreck or break-down between stations, go to the nearest marked telegraph pole (say every tenth one) where wires are brought to a locked box within reach, and establish communication with headquarters and receive orders.

It is said that revolutions never go backward. The electrical revolution began with the telegraph, 50 or 60 years ago, and in the last half of that period has surprised us with the telephone, the electric light, the electric railroad, and the electrical transmission of power. Before some of us are 50 years older, we shall be talking with the ends of the earth as we now talk to one another across the breakfast table.

Improvements in the Rogers Locomotive Works.

The Rogers Locomotive Works, Paterson, N. J., are making considerable improvements in the rearrangement of their various shops, and are adding some new buildings and extending others. A new erecting shop 265 x 100 ft. is being put up. This shop will have 16 pits, and two electric cranes will be installed, one of 100 tons, and the other 25 tons, capacity, each 60 ft. span. There is to be an extension of 90 ft. to the boiler shop, giving a total area of 290 x 126½ ft. An electric crane of 60 ft. span and 50 tons capacity will be used in this shop. A large 5-ft. gap punch has been bought, and a large boiler plate shears will be added to the shop equipment. The hammer shop will be extended a distance of 70 ft., and this will give it a total length of 220 ft. A large double frame 3,500 lb. hammer will be put in, in addition to those already in use. The upper end of the present hammer shop will be used to enlarge the flanging shop which will thus gain a space of about 50 x 50 ft.

The foundry will be increased by a space of 30 x 100 ft. The cupolas and core ovens will be moved out of the main shop into this addition, and two 10-ton electric cranes of 50-ft. span each, will be put up over the foundry floor. The enlargement of the boiler shop will give more room to the foundry, by removing the blacksmith department of the boiler shop, into the boiler shop proper. The tender shop will be made larger and will occupy a space of 185 x 200 ft. In this shop tenders will be completed, frames and tanks; and pits for ten tenders will be provided for that purpose.

A new store house is to be built on Market street close by the entrance to the works on that street. It will be a building 160 x 60 ft., with one corner cut off to accommodate the curve of the entering railroad track. A power house will be placed beside the storehouse, from which electricity will be supplied to the whole plant for lighting purposes and for operating the cranes.

All the shops will be improved by more satisfactory location of tools and methods of handling material. A new three-head frame slotter will be added to the frame shop equipment, and a new locomotive crane will handle material about the yards.

Altogether about 3½ acres of additional land has been bought, and about $250,000 will be spent in these improvements. The boiler shop will be nearing completion in about six weeks. The works now employ 1,250 men, and expect to increase their force.

TECHNICAL.

Manufacturing and Business.

The International Stoker Co. has been incorporated in New Jersey, with $250,000 capital.

Plans are now under way for the introduction of additional machinery in the plant of the Rome Locomotive & Machine Works, of Rome, N. Y., which will cost about $50,000.

The Interstate Ball Bearing Co. and the German-American Steel Ball Co. have been incorporated in New Jersey, with $1,000,000 capital, by Frederick W. G. Maack and L. C. F. Killiam, of New York.

Robert M. Burns, an expert car builder, for many years with the Pullman Co., has entered the railroad equipment business at 1503 Fisher Building, Chicago. He will handle locomotives and cars of all kinds, contractors' equipment, rails, etc.

In the rebuilding of the Royal Warehouses in Antwerp, Belgium, the Belgian Government has awarded to the Kinnear Mfg. Co., Columbus, Ohio, the contract for 422 "Kinnear" steel rolling doors. This group of warehouses is considered one of the finest in Europe.

James A. Warren, for the past 10 years connected with the Murphy Varnish Company, and most favorably known to the western and north and southwestern railroad trade, is now associated with the house of B. M. Jones & Co., of Boston and New York. Mr. Warren takes his new position July 1, and will have special charge of the department above named.

The Riverside Bridge Co. recently elected the following directors: Nelson E. Whitaker, Henry Schmulbach, F. J. Park, John A. Howard, Ernest G. Smith, Harrison Bettis and O. R. Wood. The board organized by electing Mr. Whitaker president, Mr. Schmulbach vice-president, and Mr. C. F. Dickinson, secretary. The company is considering bids for machinery and equipment for the plant, which will be located at Martin's Ferry, Ohio.

The Railway Cycle Manufacturing Co., Hagerstown, Ind., now has three European agents, located at Belfast, Ireland; Hamburg, Germany, and Rome, Italy, respectively. The company recently shipped 20 of its regular light inspection cars to Belfast, destined for South Africa, and has orders for nine cars for Rome and 13 for Germany. The demand for the product of this company appears to be universal as it reports having business from 38 different countries. Besides the light inspection cars, it builds gas and gasoline engines and is gradually working into the making of gasoline motor cars. The company is fortunate in having a natural gas well on its premises which furnishes all needed heat, light and power.

Iron and Steel.

Dr. Seward Webb has resigned as a director of the Cramp Steel Co., Ltd., of Canada.

J. O. Emanuel Trotz has been appointed chief metallurgist of the United States Steel Corporation and adviser to President Schwab. His office will be in Chicago.

A shareholders meeting of the Dominion Iron & Steel Co., Ltd., was held on Thursday of this week in Montreal to authorize the company to lease the property of the Dominion Coal Co.

Wm. S. Eaton, Treasurer of the National Tube Works of Boston and McKeesport, Pa., died at his home in Boston last week. He was one of the original organizers of the National Tube Works Co., and for 25 years was its Treasurer.

It is stated that the efforts to form a combination of expansion bolt manufacturers in the United States are making favorable progress. N. Harper Steward is acting for a syndicate of Baltimore bankers and holds options on five plants.

The new plant of the National Steel & Wire Co., building at Fair Haven, Conn., will be in operation about July 1. This plant, when fully equipped, it is said, will cost about $1,000,000. The old plant was destroyed by fire some years ago.

Last week furnace No. 3 of the Republic Iron & Steel Co. at Birmingham, Ala., was blown in. It is expected that the furnace will have a daily output of about 250 tons. It is 85 ft. high, 18 ft. 6 in. bosh diameter, with a 12-ft. hearth diameter.

Members of the steel plate pool have agreed to make no advance in prices, but it is understood that no restrictions are to be placed upon individual members of the Plate Association in their efforts to get as much as they can for their product.

E. F. Wood, who has been Assistant Superintendent of the Homestead Steel Works for about 12 years, has resigned to become Vice-President of the International Nickel Co., with headquarters at New York. This is a kindred corporation of the United States Steel Corporation.

Announcement has been made of the resignation of C. H. Halcomb as President of the Crucible Steel Co. of America, and the election of Reuben Miller to that office. W. P. Snyder has been elected President of the Clairton Steel Co., a subsidiary concern of the Crucible Company.

The Southern Car Wheel Iron Co. has been organized with $100,000, and has bought the Tallapoosa furnace in Georgia from the Georgia Vineyard Co. The furnace is now being repaired and will probably be ready to blow in early in July. Stephen N. Noble, Anniston, Ala., is President.

Some of the Cars Handled in Chicago.

In the Annual Report of the Chicago & Western Indiana Railroad we find the fact that there were 300,568 engines and cars handled in and out of the Dearborn station during the year 1901, an increase of 15,011 over the previous year. The total number of pieces of baggage handled was 728,471, an increase of 88,556. The Switching Association handled 149,471 cars, an increase of nearly 14 per cent. over the preceding year. The average cost per car was 35.94 cents. The Belt Railway handled 687,236 cars in the year, an increase of about 2 per cent. over the preceding year.

The F. M. Pease Car and Locomotive Works.

F. M. Pease writes us that he has secured 20 acres additional land and now has 26 acres at Hegewisch, Ill., to which place he is removing all of the Muskegon (Mich.) car plant. New brick shops are being built as follows: Woodworking shop, 50 x 125 ft.; forge shop, 50 x 125 ft.; machine shop, 50 x 125 ft.; also a foundry. This will give a capacity of 20 cars a day. The capacity of the locomotive shops are also being enlarged by building an addition, so that 18 engines can be handled on the floor at one time. The present storage building is 300 x 80 ft. The plant has electric light throughout.

Great Lakes Engineering Works.

This company has recently been organized through the efforts of John R. Russell, of Detroit, and has succeeded to the business of S. F. Hodge & Co., of Detroit, known for years as the Riverside Iron Works. H. W. Hoit, Vice-President of the Allis-Chalmers Co., is Vice-President, and Antonio C. Passano, Vice-President and General Manager of the Geo. V. Cresson Co., of Philadelphia, is President and General Manager. The capital stock is $200,000. The company will make marine and stationary engines, mining machinery, etc.

Vulcan Crucible Steel Co.

This new corporation, which has been operating a tool steel plant near Monaca, Pa., for several months, is to enlarge its plant, the stockholders having voted recently to increase the capital stock from $300,000 to $500,000. President Kidd, who has been at the head of the concern since its organization, has resigned and has been succeeded by John Caldwell, Treasurer of the Westinghouse Air Brake Co.

A New Spring Company.

The Iron City Spring Co. has recently incorporated in Pennsylvania to make springs. The incorporators are: Geo. M. Hosack, John A. Murphy, Harry R. Easton, Samuel M. Meyers and Chauncey Lobinger. The office is in Pittsburgh.

The Present State of Pintsch Gas Lighting.

We have an opportunity every year to print the figures of the use of Pintsch gas for lighting, as compiled by the Pintsch Company, in Berlin. The statement below shows the number of cars, locomotives and beacons lighted by this system up to May of this year. The increase as compared with the same date a year ago is 6,527 cars, or a growth of 6 per cent. In the United States the increase of cars lighted was 1,500, or almost 9 per cent. In Canada the increase in the year has been 91 cars, and in Mexico 81. In fact, we find no cars equipped in Mexico, in the list printed a year ago. The increase in locomotives equipped was 525. It is hardly necessary to say that there are no locomotives equipped for Pintsch lighting in the United States. In the United States and Canada (the territory controlled by the American Co.) there are 66 gas works, or 19 per cent. of the total Pintsch gas making works in the world; and the increase in the United States during the year was nine.

Cars, Locomotives and Buoys Lighted by Pintsch Gas, May, 1902.

	Cars.	Locomotives.	Gas works.	Buoys and beacons.
Germany	40,156	4,786	71	124
Denmark	45	.....	3	21
England	18,859	18	87	272
France	6,741	.....	27	240
Holland	3,487	5	10	86
Italy	1,528	.....	5	15
Switzerland	380	2	1	.....
Austria	4,218	.....	10	1
Russia	3,041	112	13	13
Sweden	679	43	4	2
Servia	216	.....	...	.....
Bulgaria	98	.....	1	.....
Turkey	114	.....	...	.....
Egypt	42	.....	3	118
Canada	166	.....	3	65
Brazil	974	31	1	33
Argentine	1,096	.....	10	2
Chili	46	.....	2	.....
India	9,584	.....	16	.....
Australia	2,053	.....	13	38
United States	18,497	.....	63	172
Japan	100	.....	2	4
China	.....	.....	1	15
Mexico	81	.....	1	.....
Total	112,191	4,997	347	1,211
Increase for the year..	6,427	525	11	49

A New Brake Company.

The Corrington Air Brake Company, of New York city, was incorporated at Albany, June 9, with a capital of $5,000,000, to manufacture air, electric and other brakes and appliances for locomotives, cars and vehicles. The directors are: John N. Beckley, Frederick Cook and John F. Alden, of Rochester; K. W. Blackwell, of Montreal; Elias Rogers, of Toronto; Henry M. Watson, of Buffalo; John P. O'Donnell, of London, England; and William G. Choate, Coleman Hanford, Nelson Shipman, Joseph Larocque, Jr., Charles F. Gehrmann, Charles Hansel, Clarence A. Hope and Murray Corrington, of New York city.

THE SCRAP HEAP.

Notes.

Dr. D. A. Jones, of Louisville, Ky., has been making experiments in telephone transmission to and from a moving car. The experiments were made on a car of the Louisville, Henderson & St. Louis, moving at a speed of about 10 miles an hour. It appears that some sort of physical contact is made between the car and a wire which is strung alongside the track on poles. There was no difficulty in talking over the circuit which was made, but the reports indicate that the experiments will have to be continued further before the results will be satisfactory.

The Market Street Station of the Pennsylvania Railroad at Newark, N. J., is spoken of as the largest way station in America, and, perhaps, in the world. The number of passengers getting on and off the trains at that station was counted recently and found to aggregate over 15,000 in one day. It is said that all other stations in the country that do as much business as this are classed as terminals. Even this statement does not give

an adequate idea of the size of the city of Newark, as there are two other important railroads running through the city. Newark has a population of over 200,000, and is only nine miles from New York.

It is announced that the Pennsylvania is to run a mail train from New York to St. Louis, beginning June 15, in 23½ hrs. (apparent time), or about eight hours quicker than any train was ever before regularly run between these cities. The new train is to leave New York at 2:45 a.m., and reach St. Louis at 2:15 a.m. It is also announced that the new "Pennsylvania Special" to be run between New York and Chicago will have fast train connection to Cincinnati and to Columbus. The Pennsylvania Special will not run to the Broad street station in Philadelphia; passengers will be taken and left at Germantown Junction. It is stated that no stop is scheduled for this train between Pittsburgh and Fort Wayne (320 miles).

For the service to Bar Harbor this summer from New York, through sleeping cars will be run between New York and Mount Desert, leaving New York at 9 p.m., running via Springfield, Worcester and Portland, arriving at Portland 6:40 a.m., connecting for Rockland, due there at 10:30 a.m., and arriving at Bangor 11:30 a.m. and Mt. Desert Ferry at 1:20 p.m. Returning, corresponding service will leave Mt. Desert Ferry at 2 p.m., Bangor 3:55 p.m., Portland 7:40 p.m., arriving at New York 7 a.m. A new steamer will also be placed in service, leaving Mt. Desert Island, calling at Mt. Desert Ferry, Bar Harbor, Seal Harbor, Northeast Harbor and Southwest Harbor. The train leaving New York at 9 p.m. will carry a sleeping car through to the White Mountain Resorts by the Connecticut River Route, enabling passengers to breakfast in the mountains. A sleeping car will also be attached to this train and run through to Quebec, arriving there about noon. Southbound a similar service will be in effect.—*Official Guide.*

Tariffs Must Be in Sight of the Public.

The Interstate Commerce Commission, in an opinion by Commissioner Yeomans, has announced its decision in the case of Charles H. Johnson, of Norfolk, Neb., against the Chicago, St. Paul, Minneapolis & Omaha Railway Company and others. The decision of the Commission is that the freight rates in effect from Chicago to Norfolk and from Duluth to Norfolk, are unjust and unreasonable; and upon the facts and circumstances shown in the case the rates from Chicago to Norfolk should not exceed those in force from Chicago to Columbus, Neb., and the rates from Duluth to Norfolk should not exceed the rates in force from Duluth to Emerson, Neb., added to the present local rates in effect from Emerson to Norfolk. The Commission also holds that posting a notice in a station or depot that the tariff sheets of the railroad company may be found in some other place is not compliance with the provision in the sixth section of the Act requiring the posting of rate schedules or tariffs in every such depot or station.

Department of Commerce.

The Committee on Interstate and Foreign Commerce of the House of Representatives last week decided by a vote of 7 to 4 to consider and report to the House the Nelson bill establishing a Department of Commerce, which passed the Senate some weeks ago.

The 20-Hour Trains.

The "Twentieth Century" trains that go into service on the New York Central and Lake Shore Railroads on June 15th, making the run of 980 miles between New York and Chicago in 20 hours, will be equipped with the "Axle Light" system of electric lights and fans of the Consolidated Railway Electric Lighting & Equipment Company. These trains will also be fitted with Pintsch gas lighting.

The "Pennsylvania Special" 20-hour train will be made up of one Pullman combination car, one Pullman sleeper, one Pullman compartment sleeper and one Pennsylvania Railroad dining car. These trains will be lighted by storage batteries. One of the "Chicago Limited" trains will be fitted with axle light.

Railroad Accident Insurance.

The Massachusetts Legislature has this year passed two bills to incorporate street railroad accident insurance companies. This class of insurance companies is not new in Massachusetts, as several years ago a bill was passed incorporating the Massachusetts Street Railway Accident Association. This was secured through the efforts of Mr. William H. Coolidge, general counsel of the Boston & Maine, who has been for several years interested in street railroad corporations in the vicinity of his home, Newton. The Coolidge company, some three years ago, passed into the hands of the men who control the Boston & Northern and the Old Colony (street) railroads, and all of their various lines are insured through it, as are also the companies in the systems centering about Newton. The experience with this class of insurance was so satisfactory that some of the other street railroads desired to have its benefits, but finding that it was impracticable to join with the existing company a charter was obtained for the New England Railway Assurance Company. The incorporators are George L. Hemenway, Roger F. Upham, and others. This company, it is presumed, will do business with what is known as the "Shaw" roads. Another petition was put in by Wilson Weeks and others, and resulted in the incorporation of the Bay State Accident Association. Each of these companies has similar powers and neither is allowed to insure street railroad companies against loss to property, but may insure them against loss arising from damages on account of injury to persons, or on account of death to persons. It will thus be seen that should an electric car strike a man driving a carriage, the company is insured against any damage for injury to the man, but must itself make good the damage to the carriage. The New England Company is not permitted to insure a corporation whose annual gross earnings exceed $500,000, while the Bay State Company is limited to companies earning $1,000,000.

Stevens Institute.

At a recent meeting of the Trustees of Stevens Institute, Hoboken, Mr. Alexander C. Humphreys, of New York, was elected President of the Institute to succeed the late Henry Morton. Mr. Humphreys was graduated from the institute in 1881, and is now a prominent gas engineer. He is also President of the Hibbard-Rodman-Ely Safe Company of New York, and of the Buffalo (N. Y.) Gas Company. He was elected a Trustee of the institute on Dec. 23, 1891, and was President of the Alumni Association in 1885-6. He had not accepted the presidency at our latest information.

Oil Fuel in the Merchant Service.

The new steamer "Kaiser Ferdinand Lereisz," of the Hamburg-American Line, is fitted to burn either coal or oil. It recently made a run from Suez to Hamburg with oil fuel, using Borneo oil. The special installation used for this method of heating differs from all that have been used up to the present time, in that the atomizing of the oil is not done by the direct action of the steam, but the oil, at a low pressure and after being previously heated in the delivery pipes, is projected directly into the furnace by special atomizing machines. The apparatus was designed and constructed by Koerting Brothers, of Koertingsdorf, near Hanover. The superiority of the Koerting system of atomizing by means of centrifugal action consists in the fact that steam is not directly employed to do the work, and so there is no loss of heat. The steam used to drive the oil pump and heat the pipes is taken to the condenser as water of condensation. Furthermore, the ordinary methods of atomizing with the steam jet require the consumption of 20 per cent. or more of the live steam, which passes off with the products of combustion, and thus represents the loss of just so much heat, a loss which is not incurred with the new system. In addition to this, the Koerting method, besides producing a smokeless combustion, evaporates from 20 to 25 per cent. more of water than in the old way of atomizing with a steam jet. Whether the comparative price of oil and coal will permit of the utilization of the device to the full extent of its possibilities is a question, but, in any event it is a matter of engineering importance.

New Fast Schedule Between Chicago and Denver.

The abrogation of the speed agreement between Chicago-Omaha lines by the withdrawal of the Rock Island has resulted in the formation of a new schedule by the Chicago & North Western which went into effect on Saturday, the 8th inst. A new train has been placed in service called No. 11 and known as the "Colorado Special," leaving Chicago at 6:30 p.m., reaching Omaha at 6:55 a.m. and Denver at 8 p.m. the following day. By the agreement the minimum time between Chicago and Omaha was 13 hrs. and 20 min. This has been reduced 55 min., while the time to Denver is reduced an hour and a half. This train does not affect the former service of the North Western between the points named, the trains at 10 a.m. and 11:30 p.m. continuing as heretofore, in addition to the "Overland Limited" leaving at 8 p.m. The new train eastbound leaves Denver at 1 p.m. and Omaha at 3:45 a.m., arriving in Chicago at 4 p.m. A train from Des Moines to connect with this train leaves there at 7 a.m.

Northern of France, Summer Service.

Through the courtesy of one of the officials of this road, we are enabled to give the summer service, some of which is very fast. The trains between Paris and Calais, Paris and Lille and Paris and Germany are all materially accelerated. The trains to Calais now take 3 hrs. and 20 min., a gain of 20 min.; 3 hrs. 26 min., a gain of 15 min., and 3 hrs. and 5 min., a gain of 5 min.; this latter train being scheduled to do the 180½ miles at slightly better than 60 miles an hour. This is a world's record for the distance. With regard to the Lille trains, the 154.3 miles are now run in 3 hrs., a gain of 14 min., and in 2 hrs. 45 min., a gain of 22 min., while in the opposite direction, the quickest train is 2 hrs. and 56 min., a gain of 4 min. In all these runs there are at least two if not three stops. The trains to the French Frontier to Joumont are accelerated. The 148¾ miles from Paris with one stop of four minutes is to be run in 2 hrs. 39 min., a gain of 6 min. These and other good trains constitute a summer service that would deserve the highest praise no matter what railroad had introduced it.

Railroad Accidents to Dec. 31, 1901.

The Interstate Commerce Commission announces the issue of Accident Bulletin No. 2, showing train accidents and casualties to persons, for the three months ending Dec. 31, 1901. The number of persons killed in train accidents was 274, and of injured 2,089. Accidents of other kinds bring the total number up to 813 killed, and 10,235 injured. There were 1,481 collisions and 877 derailments, resulting in 51 fatal accidents to passengers and 751 injured. The damage to cars, engines and roadway by these accidents amounted to $2,075,091.

Pneumatic Tools in British Shipyards.

The Glasgow (Scotland) *Evening Times* of May 23 contained an item on the above subject that is of interest as being in the line of the recent awakening of the heads of British industries to a realization of the fact that if they wished to keep abreast of the times and compete successfully with Americans and Germans in the commercial world they must adopt improved methods and appliances. This item states that the Secretary of the Clyde Shipbuilders' Association in conjunction with Messrs. John Macdonald & Sons, local agents for the Chicago Pneumatic Tool Co., had arranged for a six weeks trial of pneumatic tools of all kinds, beginning June 1, in the yard of Scott & Co., Greenock. Three expert workmen from Chicago were sent over especially for this test, to work in conjunction with three men from Macdonald & Sons'. The tools for the test are those used recently on the American liner "Zeeland" at Southampton and later on the Cunard liner "Etruria" at Liverpool. The work on the "Etruria" involved putting on a new stern piece, requiring 1½-in. rivets through 9½-in. material, a very heavy piece of work. The test will include all kinds of shipyard work such as shell and deck riveting, caulking, chipping, boring and reaming, giving opportunity for experimenting with all of the various kinds of pneumatic tools. Practically all of the leading ship-builders of Great Britain accepted invitations to be present at the tests.

Scalpers' Frauds.

A fraudulent ticket has recently been taken up on the Wabash Railroad, purporting to have been issued by the "Willamette River Navigation Company." Lately another ticket of the same issue has been presented for passage upon the Louisville & Nashville. This ticket read as follows: "St. Louis, Mo., to Geneva, Ala., Form Skel. 55, No. 517, via W. R. N. Co.; C. M. & St. P.; C. & A.; L. & N.," with the stamp W. R. N. Co., Bayview, Wis., May 12, 1902, and limited to May 15th. The ticket was presented for passage by a discharged soldier on his way home to Birmingham, Ala. He stated that he had bought it from ticket brokers in St. Louis. This is undoubtedly one of the class of tickets which was referred to at the recent session of the Association of Ticket Brokers at Chicago, when it was stated by a prominent "broker" that no legislature would attempt to interfere with it because it would be "a discrimination against the poor." The "Willamette River Navigation Company," not being encumbered by traffic of its own, is able to supply tickets over other roads to the "poor" at bargain-counter rates. A communication on this subject just received from a prominent general passenger agent includes the following pertinent remark: "Tickets are just the same as greenbacks. How long would the Government permit those scalpers to exist if they were molested as we are? The increased boldness of these counterfeiters and manipulators is alarming."—*Official Guide.*

LOCOMOTIVE BUILDING.

The Chicago, Peoria & St. Louis is having three locomotives built at the Rogers Works.

The National of Mexico is having three locomotives built at the Cooke Works of the American Locomotive Co.

The Baltimore & Ohio has ordered from the American Locomotive Co. 75 consolidation, 15 switch and 10 passenger locomotives.

The Pittsburgh, Chartiers & Youghiogheny is having one locomotive built at the Dickson Works of the American Locomotive Co.

The El Paso & Southwestern has placed an order for two 18 x 26 50-ton freight engines rebuilt at the Hicks Locomotive & Car Works.

The Lake Shore & Michigan Southern is having 12 locomotives built at the Brooks Works of the American Locomotive Co., in addition to the order reported in our issue of Jan. 17.

CAR BUILDING.

The Southern is reported in the market for 700 cars.

The Atlantic & Birmingham is in the market for 200 cars.

The Lehigh Valley is having two coaches built at the Pullman Works.

The Fayette Coal Co. is having 10 freight cars built by the Pressed Steel Car Co.

The Iowa & St. Louis has ordered 500 coal cars from the American Car & Foundry Co.

The American Car & Foundry Co. has orders for 52 cars of various types for different parties.

The Cincinnati, New Orleans & Texas Pacific has ordered 200 box cars from the American Car & Foundry Co.

The Cincinnati, Hamilton & Dayton has ordered 200 coal cars, to be built at the American Car & Foundry Company.

The Galveston, Houston & Henderson is having 15 freights built at the Madison Works of the American Car & Foundry Co.

The Lake Erie & Detroit River has ordered from F. M. Hicks 200 60,000 lbs. gondolas, rebuilt by the Hicks Locomotive & Car Works.

The Illinois Central has ordered 800 box cars from the American Car & Foundry Co., 200 of which will be built at the Mt. Vernon Works.

The Bessemer Coke Co. has ordered from F. M. Hicks 20 drop bottom gondolas of 30 tons capacity, rebuilt by the Hicks Locomotive & Car Works.

The Pittsburgh & Lake Erie has ordered two combination baggage and mail, and one combination passenger and baggage car, to be built by the American Car & Foundry Company.

F. M. Hicks, of the Hicks Locomotive & Car Works, has received orders for rebuilding cars from Darling & Co., Chicago; the Dow Chemical Co., Midland, Mich.; the Deering Harvesting Co., and L. S. Cass, Waterloo, Iowa.

The Southern Pacific order with the American Steel Foundry Co. for 300 eight-wheel self-clearing dump cars, calls for metal cars of 100,000 lbs. capacity, length 31 ft. outside and 30 ft. inside drawbars, width 9 ft. 8 in., height 9 ft. 7¾ in. The special equipment includes Southern Pacific standard brake-beams, cast-iron brake-shoes, Tower couplers, Miner draft rigging, American steel trucks and 33 in. cast-iron wheels.

The Cincinnati, Hamilton & Dayton order reported in our issue of May 23 should read, 110 side dump cars to be built at the company's Lima shop this summer. Capacity, 60,000 lbs.; weight of cars, 24,000 lbs.; length, 33 ft. 1¾ in.; width, 9 ft. 3 in.; height, 5 ft., to be built of wood with wood underframes. The special equipment calls for hammered iron axles, Simplex bolsters, Sterlingworth brake-beams, cast-iron brake-shoes, Westinghouse air-brakes, Hewitt brasses, Buckeye couplers, Butler pocket draft rigging, American dust guards, cast-iron journal boxes, pressed steel journal box lids, Mineral paint, Detroit springs and Diamond trucks.

The Chicago, Rock Island & Pacific order with the Pullman Co. for two dining and four observation cafe cars is for October delivery. The dining cars will be 78 ft. long, 10 ft. 4 3/16 in. wide, and 15 ft. ½ in. high over all. The observation cafe cars will be 78 ft. 2½ in. long, 10 ft. ¼ in. wide and 15 ft. 2½ in. high over all. The special equipment for both includes National Hollow brake-beams, Christie cast-iron brake-shoes, Westinghouse air-brakes, Janney couplers, Forsyth curtain fixtures, Safety heating system, Fletcher steel journal box lids, standard steel type "A" platforms, French springs, Chicago & Rock Island standard (six-wheel) trucks, Pullman standard wide vestibules and 36 in. McKee-Fuller wheels.

The St. Louis & San Francisco placed an order with the American Car & Foundry Co. on May 22 for 600 box cars of 60,000 lbs. capacity. Weight of cars, 32,000 lbs.; length, outside measurement, 36 ft. 6 in.; width, 9 ft. 1 in.; height, 6 ft. 1½ in., to be built of wood with metal underframes. The special equipment includes M. C. B. axles, Sterlingworth brake-beams, cast-iron brake-shoes, M. C. B. brasses, Trojan couplers, two end and two side doors and Lawler grain doors, Miner draft rigging, wooden dust guards, M. C. B. Standard journal boxes, malleable iron journal box lids, Frisco standard paint, Chicago metal roofs, Scott springs, Diamond trucks and double plate wheels. These cars are for October and November, 1902, delivery.

The Missouri Pacific order reported in our issue of May 30 with the American Car & Foundry Co., calls for 15 baggage, 10 combination baggage and mail, and five postal cars for September, October and November delivery. The baggage cars are to be 60 ft. long, 9 ft. 2½ in. wide,

and 9 ft. 3¾ in. high. The combination baggage and mail cars and the postal cars will be 60 ft. long, 9 ft. 3½ in. wide and 9 ft. 5⅛ in. high, all inside measurements. The special equipment for all includes Diamond special brake-beams, Westinghouse air-brakes, Universal brasses, National couplers, Baker heating system, McCord journal boxes and lids, Pintsch lights, Missouri Pacific standard paint and roof, American Car & Foundry Company's platforms, Pickering springs and American Car & Foundry Company's 33 in. cast-iron wheels.

BRIDGE BUILDING.

BENTON HARBOR, MICH.—We are told that nothing is decided in regard to building two bridges over the St. Joseph River and Pere Marquette Railroad by Benton Township and the city of Benton Harbor.

BRATTLEBORO, VT.—The Brattleboro & Hillsdale Bridge Commissioners have engaged L. F. Liscom to make plans, etc., for the proposed steel bridge.

CHICAGO, ILL.—The Sanitary District is already having plans made for a new bascule bridge at Dearborn street to take the place of the structure now there.

CLINTON, IND.—By a mistake last week it was stated that bids were wanted, June 17, at Clinton, Iowa, for a bridge over Norton Creek. It should have been Clinton, Ind.

COLUMBIA CITY, IND.—Bids are wanted by Wm. H. Carter, County Auditor, until 2 p. m., June 13, for building four stone culverts and two stone abutment walls.

Mr. Carter will let contracts on July 7 for three small steel bridges; also one 48-ft. steel truss bridge and two stone culverts in various parts of the county.

COLUMBUS, GA.—Bonds for $40,000 are to be issued for the steel bridge over Chattahoochee River, connecting Columbus, Ga., and Phœnix City and Girard, Ala. Address the Mayor.

CONWAY, S. C.—D. T. McNeill, General Manager of the Conway & Seashore R. R., tells us that no plans have been decided upon for the steel bridge to cross the Waccamaw River at Conway which has just been authorized by Congress. The total length will be about 200 ft.

EGANVILLE, ONT.—Bids are wanted, June 18, according to report, for a bridge across Bonnechere River. S. E. Mitchell, County Clerk, Pembroke, Ont.

ELDORA, IOWA.—Bids are wanted, June 16, by Jay S. Newcomer, County Auditor, for a steel bridge 1¾ miles northeast of Town Hill.

EVERSON, PA.—The Pittsburgh, McKeesport & Connellsville Street Ry. will build a bridge over Jacob's Creek at this place.

FORT WAYNE, IND.—Bids are wanted June 25 for the substructure of concrete and iron, steel and concrete arches, according to plans and specifications on file with the County Auditor, G. C. A. Ortlieb.

FREDERICTON, N. B.—C. P. LaBillois, Chief Commissioner of Public Works, is asking for tenders up to Sept. 1, for rebuilding Leprean Station bridge in Charlotte County; up to June 9, for rebuilding Isadore Barrian Brook bridge, in Kent County, and up to June 16, for rebuilding Sebastian Babineau bridge, in Kent County.

FREEHOLD, N. J.—The County Freeholders of Monmouth County have voted to spend $102,500 on bridge work, divided as follows: Atlantic, $3,500; Eatontown, $3,500; Freehold, $4,000; Holmdel, $7,500; Howell, $7,500; Manalapan, $9,000; Millstone, $4,000; Matawan, $4,500; Marlboro, $8,500; Middletown, $8,000; Neptune, $4,000; Ocean, $8,000; Raritan, $4,500; Shrewsbury, $5,500; Upper Freehold, $5,000; Wall, $11,500; Second Ward, Asbury Park, $4,000.

FREEPORT, ME.—According to a decision of the Railroad Commissioners, the Portland & Brunswick Street Ry. will be required to build an overhead bridge where it will cross the Maine Central tracks.

HARRISBURG, ILL.—We are told that a steel bridge has been voted for. Address Town Clerk E. Hutcheson.

HARRISBURG, PA.—The Pennsylvania Railroad has represented to the Middletown Borough Council that unless some interested property owners scale their prices considerably the matter of abolishing dangerous grade crossings by the construction of subways at Union and Catharine streets will be indefinitely postponed.

Judge Simonton has approved reports of bridge viewers as follows: Rebuilding of bridge over the Schuylkill River in Berks County, and for the rebuilding of a bridge over Red Bank Creek at Brookville, Jefferson County.

HOLYOKE, MASS.—Contract for building the South Holyoke canal bridge at Main street has been let to Rivers & Young.

INDIANAPOLIS, IND.—Bids are wanted, June 17, by the County Commissioners, for nine concrete and stone arch bridges and on July 1 for one concrete and stone arch bridge and two plate girder bridges. H. B. Smith, County Auditor.

The County Commissioners are also advertising for bids until July 8 on two plate girder bridges to be stone arch and several concrete arches.

KANSAS.—A bill was introduced in the House of Representatives on June 5 authorizing a bridge across the Missouri River, within five miles of the mouth of the Kaw River, in Wyandotte County, Kans., and Clay County, Mo.

KANSAS CITY, MO.—The viaducts over street crossings that Alderman Knepp will take measures to have the railroads and street railway company in Kansas City build are proposed for the following places: In Eighth street across the tracks of the Frisco system and Chicago & Great Western in Santa Fe street; over the Belt Line in Summit near Twenty-fourth; over the Belt Line in Broadway; over the Belt Line in Holmes; over the Belt Line in Forest; over the Belt Line in Indiana; over the Belt Line in Fifteenth; over the Missouri Pacific and Chicago & Alton tracks where what was known as the Heim line crosses in Lydia avenue. Within 60 days Mr. Knepp expects to have proceedings started to accomplish all of these improvements. (June 6, p. 420.)

LOS ANGELES, CAL.—The City Council has passed resolutions declaring that it is necessary to build several bridges. Included in the estimates are: A steel and wooden bridge across the Los Angeles River and the tracks of the San Pedro, Los Angeles & Salt Lake road at Fourth street, $50,000; steel and wooden bridge across Los Angeles River at Aliso street, $27,100; steel and wooden bridge across Los Angeles River at Macy street, $9,650; steel and wooden bridge across Arroyo Seco at Pasadena avenue, $8,350; steel and wooden bridge across Arroyo de los Posos at Macy street, $4,900.

MALDEN, N. Y.—Two bridges are to be built over Tenbrook stream, for which $7,000 is appropriated. James T. Young, Village Clerk.

MEMPHIS, TENN.—The Nashville, Chattanooga & St. Louis, according to report, contemplates removing the wooden trestles on Broadway and substituting iron structures.

MILWAUKEE, WIS.—Local reports state that definite steps will soon be taken toward building the Kinnickinnic Avenue viaduct. The railroads, it seems, are willing to do their share.

MINNESOTA.—In the U. S. Senate on June 6 a bill was introduced authorizing the St. Paul & Winnipeg Ry., of Minnesota, to build a bridge across the Mississippi River.

NAPA, CAL.—It is said the City Clerk is to receive bids for a stone bridge over Napa Creek at Pearl street.

PEKIN, ILL.—A new superstructure will probably be built to the wagon bridge which is now receiving the attention of the City Council.

PERTH AMBOY, N. J.—The Board of Freeholders has voted to issue $150,000 of bonds to build the foot and wagon bridge over the Raritan River between Perth Amboy and South Amboy. Resolutions were also adopted for submitting the plans, as presented by the American Bridge Co., in April, to the War Department for approval.

SAULT STE. MARIE, ONT.—The International Transit Co. has made an agreement with the city to build a bridge over Hudson Bay Creek.

SHELBYVILLE, MO.—Contract will be let on June 20 for a 121-ft. steel high truss bridge over North River, near Bethel. Address W. W. Mitchell, Bridge Commissioner.

SIOUX CITY, IOWA.—According to local reports, the Chicago & North Western, which has just finished a $25,000 steel bridge over the Floyd, will, if the city fulfils its proposed plans for river improvements, be required to build a bridge over the canal, at a cost of about $25,000.

TATE, GA.—We are told that bids will be advertised for within a month by the County Commissioners at Jasper for a bridge over Long Swamp Creek near Tate.

VICTORIA, B. C.—The City Council has decided to have new plans prepared by the City Engineer for the superstructure of a bridge at Point Ellice.

WALNUT, ONT.—A vote of the ratepayers of Brooke Township will be taken on a by-law to raise $9,000 by debentures for the erection of two steel bridges.

WASHINGTON, IND.—The County Commissioners have ordered an election to decide on building two steel bridges over White River, connecting Daviess and Knox counties. The estimated cost of the bridges is $32,000.

Other Structures.

ALLEGHENY, PA.—Extensive improvements are under consideration for the Allegheny shops of the Fort Wayne road, but the plans will be delayed somewhat by the proposed track elevation through Allegheny. The present machine shop and locomotive repair shop and the store room will be torn down and new buildings erected on another site.

CHICAGO, ILL.—Plans for a new steel plant, to be built at South Chicago by the Deering Harvester Co., provide for an open-hearth plant of 14 furnaces, 14 tons daily capacity, of which only seven will be built at present.

CLEVELAND, OHIO.—The contract for the new plant of the Interstate Foundry Co. on Tod street has been given to Hunkin Bros. The building is to be one-story high (60 ft.) and 300 by 250 ft.

GREENWICH, CONN.—It is said that the New York, New Haven & Hartford will build a stone station at Greenwich similar to those at Rye and Larchmont. There will be a building on each side of the track.

HAMMOND, IND.—The Monon road is reported to have bought 80 acres of land at Hammond upon which, it is said, car and repair shops will be built.

KANSAS CITY, MO.—The Metropolitan Street Ry. Co. within a short time expects to begin work on a new and larger power plant.

LOS ANGELES, CAL.—According to despatches from this place, arrangements have practically been completed to build a large wire plant on the Pacific coast. It is said those chiefly interested are Henry E. Huntington, of Los Angeles, and D. O. Mills, of New York.

MONROE, LA.—It is said that the Missouri Pacific has set aside $21,000 for a new passenger depot in Monroe.

NEW BRITAIN, CONN.—The Stanley Electric Co., it is said, has applied to the Council for permission to build six factory buildings.

NEW ORLEANS, LA.—It is stated that the New Orleans Ry. Co. will soon begin work on a new car barn and shops near Metairie.

OROVILLE, CAL.—The Feather River Power Co., which has been incorporated by Chas. Webb Howard, Chas. L. Fair and others, of San Francisco, has a capital stock of $5,000,000. An electric power plant, with a capacity of 20,000 h.p., will be installed at the Big Bend tunnel, which is 12,000 ft. long. The water power plant will be installed as soon as possible and the electricity will be transmitted to San Francisco via San Jose. The dam and water tunnel were built some years ago by a mining company whose property has been bought, so the amount of hydraulic construction work required will be comparatively small. No reservoirs will have to be built. The location of the plant is 20 miles north of Oroville.

REDDING, CAL.—A large iron-making plant will be established on Pitt River near ore beds 30 miles northeast of Redding, in Shasta County, by a company of St. Louis capitalists. The McCloud River Electric Power Co. will supply the power.

SAVANNAH, GA.—At a meeting of the stockholders of the Savannah Union Station Co., held recently, it was decided to issue $600,000 of 4 per cent. 50-year bonds, to begin work on the new station.

SAYRE, PA.—In regard to reports that the Lehigh Valley has completed plans for the extensive shop improvements at Sayre, we are told by an officer of that company that the plans have not been worked into final shape.

TACOMA, WASH.—The Tacoma Steel Co. have bought large iron ore deposits in Washington and British Columbia, and will build large blast furnaces between Seattle and Tacoma. J. F. Bledsoe, of Vancouver, B. C., is engineer for the company.

WINNIPEG, MAN.—An officer of the Canadian Northern tells us that nothing definite has yet been decided upon in regard to the extensive improvements to the shops at Winnipeg, which are supposed to cost about $500,000.

YOUNGSTOWN, OHIO.—The Riverside Foundry has been incorporated under the new name of the Wright & Finnie Foundry Co. by William B. Wright, James Wright, John W. Wright, Alexander Wright, M. Finnie.

MEETINGS AND ANNOUNCEMENTS.

(For dates of conventions and regular meetings of railroad associations and engineering societies see advertising page xlii.)

Car Foremen's Association of Chicago.

The regular meeting of the Car Foremen's Association of Chicago will be held in room 209, Masonic Temple, Chicago, Wednesday, June 11th, at 8 o'clock p.m. The following programme has been arranged:

1. Should settlement be made by joint evidence card or by defect card under the following conditions:
(a) Car delivered home *without* repair card and having proper repairs, which in connection with existing defects would form a combination, all damage appearing to have been caused at one and the same time.
(b) Car delivered home *with* repair card attached, in condition as outlined above.
2. Discussion of that part of the report of the Committee on Repair Track Facilities and Appliances, which refers to the clerical work in connection with repair tracks.
3. Inspections of cast iron car wheels in interchange.
4. Discussion of M. C. B. Rules 4, 5 and 6.

Engineers' Club of St. Louis.

The 546th meeting was held at the rooms of the club, 709 Pine street, on Wednesday, June 4th, 1902, at 8 p.m., with Vice-President Van Ornum in the chair, who introduced Mr. R. H. Tait, who read a paper entitled "Mechanical Refrigeration."

Early attempts at refrigeration were described. The first storage house was built in 1858 and used ice as the refrigerant. The scheme included a drying device and a ventilating fan similar to those used to-day. Some years later the method was greatly improved by the use of a mixture of salt and ice, which produced a much lower temperature.

Refrigerating machines were built as early as 1775. These early machines all used rapid evaporation as the means for producing cold temperatures. The first compression machine was built in 1834 and used ether as the refrigerating medium. The system most largely used to-day is the "ammonia compression" system. Ice-making and refrigerating machines are now made of any desired capacity. The cost of a plant, exclusive of buildings, will range from $2.500 per ton for a plant making one ton of ice per day to about $500 per ton for a hundred ton plant. The cost of production will be about $4.50 per ton for a one-ton plant and about 60 cents to 70 cents for a hundred-ton plant.

The distribution of refrigeration from a central station is a comparatively new art, but has passed the experimental stage. The first pipe-line system was laid in Denver in 1899 and the second in St. Louis in 1900. The methods of construction of the pipe-line, of making connections to customers and the details of operation were described. The service supplied ranges from a single beer faucet in a saloon to large cooling chambers in the packing houses.

The present pipe-line in St. Louis includes about 12,000 ft. of mains and 5,000 ft. of laterals. An additional 11,000 ft. of mains now under construction will make the St. Louis refrigerating pipe-line the largest in the world.

In the discussion which followed, Messrs. Klauder, Humphrey, Ashton, Trepp, Bary, Russell and others participated.

Society for the Promotion of Engineering Education.

Following is the programme for the tenth annual meeting of the Society for the Promotion of Engineering Education at Pittsburgh, Pa., June 27 and 28, 1902, in the lecture hall of the Carnegie Institute:

Friday Morning, June 27—Meeting of the Council. General session. Reports of officers; Election of members; General business, and President's address. "The Efficiency Factor in Engineering Education," by Robert Fletcher, Director of the Thayer School of Civil Engineering, Dartmouth College.

Papers presented:

"The Needs of Engineering Colleges." N. Clifford Ricker, Dean of the College of Engineering, University of Illinois.

"The Value of Non-resident Lectures on Engineering Subjects." A discussion. William D. Pence, Professor of Civil Engineering, Purdue University; George F. Swain, Professor of Civil Engineering Massachusetts Institute of Technology; Robert H. Thurston, Director of Sibley College, Cornell University; Palmer C. Ricketts, President and Director, Rensselaer Polytechnic Institute.

Friday Afternoon—

"Methods of Grading Students in Engineering Colleges." Charles P. Matthews, Associate Professor of Electrical Engineering, Purdue University.

"The Subdivision of the Field of Chemical Engineering Education." Edward Orton, Jr., Professor of Ceramics, Ohio State University.

"Electrochemistry as an Engineering Course." Charles F. Burgess, Assistant Professor of Electrical Engineering, University of Wisconsin.

Adjourned discussion of the first three topics of Professor Raymond's paper, 1901. See *Proceedings*, Vol. IX, pages 142-148. Arthur N. Talbot, Professor of Municipal and Sanitary Engineering, University of Illinois; Cady Staley, President Case School of Applied Science; Carl L. Mees, President Rose Polytechnic Institute.

Report of the Committee on Technical Books for Libraries. Charles F. Burgess, Chairman.

Saturday Morning—Meeting of the Council. General Session. Election of members; Election of officers; General business.

"Courses of Instruction in Irrigation Engineering." Elwood Mead, Professor of the Institutions and Practice of Irrigation, University of California.

"Laboratory Notes and Reports." Francis C. Caldwell, Professor of Electrical Engineering, Ohio State University.

"Some Abuses of the Lecture System." A discussion. Arthur W. French, Professor of Civil Engineering, Worcester Polytechnic Institute.

Report of the Committee on Statistics of Engineering Education. William F. Magruder, Chairman.

Saturday Afternoon—

"Management of College Athletics." Calvin M. Woodward, Dean of the School of Engineering, Washington University.

"Over-development in Engineering Laboratory Courses." Frederick P. Spalding, Professor of Civil Engineering, University of the State of Missouri.

Report of the Committee on Entrance Requirements for Engineering Colleges. Harry W. Tyler, Chairman; John J. Flather, Secretary.

Further discussion on "Excessive Differentiation in Engineering Courses." See Professor Nagle's paper and its discus-

sion, 1901, in *Proceedings*, Vol. IX. pages 112-141. Edgar Marburg, Professor of Civil Engineering, University of Pennsylvania; Calvin M. Woodward, Dean of the School of Engineering, Washington University; William T. Magruder, Professor of Mechanical Engineering, Ohio State University; C. Frank Allen, Professor of Railroad Engineering, Massachusetts Institute of Technology.

PERSONAL.

—Mr. H. G. H. Reed, who was at one time Chief Engineer and General Superintendent of the Milwaukee, Lake Shore & Western, died at his home in Braidentown, Fla., on June 1, aged 74 years.

—Professor William Forsyth, of Purdue University, having charge of Car and Locomotive Design, has been granted a leave of absence for one year. Professor and Mrs. Forsyth sailed on the 7th inst. for a European trip with the expectation of remaining several months abroad.

—Mr. J. F. Walsh, who becomes Superintendent of Motive Power of the Chesapeake & Ohio, succeeding Mr. W. S. Morris, was formerly Mechanical Expert of the Galena Oil Company. Mr. Walsh was born in Cleveland, Ohio, in 1857. He was graduated from the Parochial schools in that city and afterwards from the Spencerian College. He began his railroad service as an apprentice on the Bee Line, later becoming Fireman and Engineer. For six years (1884-1890) he was a foreman on the Cleveland, Cincinnati, Chicago & St. Louis, and since then has been with the Galena Oil Company.

—Mr. M. J. McCarthy, Division Master Mechanic of the Michigan Central, was born in Susquehanna, Pa., in 1864, and got his first railroad experience in the Erie shops at that point. In 1890 he went with the Chicago, Burlington & Quincy, and in 1896, when piece work was introduced by the present General Superintendent, Mr. Deems, of the American Locomotive Works at Schenectady, N. Y., who at that time was Master Mechanic at Burlington, Mr. McCarthy became piece work inspector and three years later was made General Foreman. He received his present position as above on June 1. last.

—The new Superintendent of Passenger Transportation of the New York Central & Hudson River, Mr. Charles F. Smith, started his railroad service with this company as a messenger boy at the age of 13 years. In 1887 he was transferred to the Superintendent's office of the Harlem Division at White Plains. Then for one year he served as a stenographer for the Assistant General Superintendent. From 1890 to 1893 Mr. Smith held a similar position in the office of the Superintendent of the Hudson Division. Then for two years he was Secretary to the late Mr. Toucey, then General Manager. From 1895 to 1898 he was chief clerk to the Superintendent of the Western Division at Buffalo, and came from this division to New York City in 1898 to take the position of chief clerk in the office of the General Superintendent, which position he has held until his recent promotion.

—Mr. Geo. B. Francis has resigned his position as Chief Engineer of the street railroad system of Providence, R. I., to accept a position as Civil Engineer with Westinghouse, Church, Kerr & Co., of New York. This company is engaged in a number of engineering projects in various parts of the United States and also as engineers of the Pennsylvania Railroad Company in its New York tunnel and terminal, for a large number of features of the work. In his connection with Westinghouse, Church, Kerr & Co. Mr. Francis will necessarily have to do with this work, as well as their other undertakings. Mr. F. N. Bushnell has been appointed Chief Engineer to fill the vacancy. Mr. Bushnell has heretofore held the position of Chief Mechanical Engineer for the street railroad company and the Narragansett Electric Lighting Co., and in charge of the various power stations. It is understood that he will still retain his former position.

—Mr. Emanuel B. Sheffer, Purchasing Agent of the Erie, who was recently granted leave of absence on account of ill health, died suddenly June 9, in New York City. Mr. Sheffer was born Jan. 2, 1848, in East Germantown, Ind., and entered railroad service in 1865. He was with the Northern Central as telegraph operator and clerk until 1872, when he became connected with the United States railway mail service, between Baltimore, Washington and Grafton. From April, 1874, until the following October he was a telegraph operator on the Pittsburgh, Ft. Wayne & Chicago, and later held a similar position in the General Superintendent's office of the Pittsburgh, Cincinnati & St. Louis. He was appointed chief clerk in the office of the Vice-President of the New York, Lake Erie & Western in 1884, and three years later was promoted to the position he held at the time of his death. Mr. E. T. Campbell has assumed the duties of Purchasing Agent of the Erie, with the title of Acting Purchasing Agent.

—The Engineer of Signals of the New York Central & Hudson River, Mr. J. C. Irwin, was promoted from the position of Division Engineer of the Middle Division, which comprises the Mohawk Division of the main line and West Shore and the Adirondack line. Mr. Irwin is a native of Pennsylvania, having been born at Cheyney Sept. 23, 1868. He entered railroad service in 1888 as a topographer and instrumentman on the Wilkesbarre & Western and worked on various surveys until 1891. Mr. Irwin graduated from the University of Pennsylvania with the degree of B. S. in 1890 and C. E. in 1891. During the year 1891 and 1892 he was Engineer of the Atlantic Refining Company at Point Breeze, Pa., and instructor in Civil Engineering of the University of Pennsylvania. In July, 1892, he entered the service of the Central, having charge of outside work, constructing the block signal system from Albany to Buffalo. He then became Assistant Trainmaster of the Mohawk Division at Utica, and was later made Assistant Superintendent of Signals in charge of the signals on this division, and was at the same time Superintendent of the Hudson River Bridge Company at Albany. He was appointed to the position he has just left, that of Division Engineer of the Middle Division, in 1898.

—It is announced that Herr von Borries (Regierungs und Baurath, Prussian State Railroads), well-known to many readers of the *Railroad Gazette* as an occasional contributor to our columns, and as having been for many years connected with the Prussian State Railroads, with headquarters at Hannover, has been called to a professorship in the Imperial Technical High School at Berlin, where he will be concerned with matters relating to railroad equipment. In his new position Herr von Borries expects to be instrumental in bringing into existence a locomotive testing plant similar to that possessed by Purdue University in this country. Herr von Borries was a member of the Jury of Awards in the Transportation Department at the International Exposition in Chicago in 1893, is the author of many scientific papers, and of several formal volumes, all concerning various phases of railroad equipment. The von Borries two-cylinder compound locomotive as a distinctive type was much talked of in this country 10 years ago when types of compounds were under discussion, and is one that has since continued to make steady progress upon European roads. It is of interest to note that the call of Herr von Borries to Berlin brings to the largest and most important technical school in Germany one of the most eminent railroad men of the empire.

ELECTIONS AND APPOINTMENTS.

Arkansas Southern.—W. W. Brown has been appointed Auditor, with headquarters at Ruston, La., succeeding R. W. Huie, resigned.

Blackwell, Enid & Southwestern.—C. A. DeHaven has been appointed Master Mechanic, with headquarters at Cordell, Okla. T., succeeding J. F. Sechler, resigned.

Boston & Albany.—H. C. Blood with the title of Assistant General Freight Agent, will assume the duties of General Freight Agent, succeeding H. Perkins, resigned.

C. W. Bliss, General Agent at Springfield, Mass., has resigned.

Brooklyn Rapid Transit Co.—The position of General Manager has been abolished and J. C. Brackenridge becomes Chief Engineer of Construction. W. W. Wheatly, Superintendent of Surface Lines, will assume part of the duties formerly discharged by Mr. Brackenridge.

Brunswick & Birmingham.—R. A. Fairbairn has been elected Vice-President and C. J. Bushnell, Secretary and Treasurer.

Central New England.—W. A. Brown has been appointed Master Mechanic with headquarters at Hartford, Conn., succeeding W. C. Ennis, resigned, effective June 10.

Central of Georgia.—H. A. Dunn, Auditor, with headquarters at Savannah, Ga., has resigned.

Chesapeake & Ohio.—John D. Potts, Assistant General Passenger Agent at Richmond, Va., has been transferred to succeed C. B. Ryan, Assistant General Passenger Agent at Cincinnati, Ohio.

Chicago & North Western.—Walter P. Marsh has been appointed Car Service Agent, succeeding E. E. Betts.

Chihuahua & Pacific.—Grant B. Schley has been elected President and C. L. E. de Gaugue succeeds Mr. Schley as Treasurer.

Cincinnati, Georgetown & Portsmouth.—P. T. Dunn has been appointed Superintendent, with headquarters at Cincinnati, Ohio, succeeding J. M. Myers, resigned.

Columbus, Sandusky & Hocking.—F. R. Barrett has been appointed Engineer of Maintenance of Way, with headquarters at Columbus, Ohio, succeeding M. J. Caples.

Denver & Rio Grande.—H. E. Whittenberger, heretofore Trainmaster of the Grand Trunk, has been appointed Acting Superintendent of the Fourth Division of the D. & R. G., with headquarters at Alamosa, Colo., succeeding F. S. Harris, resigned.

Eastern of Minnesota.—See Great Northern.

Erie.—August Mordecai, heretofore Assistant Chief Engineer, has been appointed Engineer of Maintenance of Way. F. A. Clark has been appointed Auditor of Traffic, with headquarters at New York, succeeding A. T. Cuddeback, resigned. J. W. Fawcett, Division Engineer, with headquarters at Youngstown, Ohio, has resigned.

Great Northern.—J. F. Stevens, Chief Engineer, will also assume the duties of General Manager. The title of W. W. Broughton, Traffic Manager of the Eastern of Minnesota, has been changed to General Freight Agent of the Eastern Division.

Gulf, Colorado & Santa Fe.—F. L. Carson has been appointed Master Mechanic of the Northern Division, with headquarters at Cleburne, Texas, succeeding John R. Mitchell, resigned. C. W. Tait succeeds Mr. Carson as General Foreman.

Hannibal & St. Joseph.—C. M. Levey, General Manager, will, until further notice, assume the duties of the General Superintendent.

Illinois Central.—F. E. Place, Master Mechanic at Waterloo, Iowa, has been transferred as Master Mechanic of the Burnside Shops, with headquarters at Chicago, Ill.

Minneapolis & St. Louis.—E. T. Campbell having resigned, Fred Wing, Purchasing Agent of the Iowa Central, has been appointed Purchasing Agent of the M. & St. L., with headquarters at Minneapolis.

Minneapolis, St. Paul & Sault Ste. Marie.—Arthur M. Sharpe has been appointed Acting Superintendent of the Minnesota Division, with headquarters at Enderlin, N. D., succeeding C. P. Eckels, resigned.

New York Central & Hudson River.—Charles F. Smith, heretofore Chief Clerk to the General Superintendent, has been appointed Superintendent of Passenger Transportation.

Pittsburgh, Shawmut & Northern.—George Howes has been appointed Purchasing Agent, with headquarters at 25 Broad street, New York City.

St. Louis, Iron Mountain & Southern.—R. H. Dwyer has been appointed Superintendent of the Little Rock Terminals, with headquarters at Little Rock, Ark., succeeding H. H. Brewer, resigned.

Shreveport & Red River Valley.—E. C. D. Marshall has been appointed Assistant General Freight Agent, with headquarters at Shreveport, La.

Southern.—S. Higgins, heretofore Superintendent of Motive Power and Machinery of the Union Pacific, has been appointed Superintendent of Motive Power of the Southern, with headquarters at Washington, D. C., effective July 1. Mr. Higgins succeeds W. H. Thomas.

The headquarters of A. Gordon Jones, Superintendent of the Washington Division, have been removed from Charlottesville, Va., to Alexandria, Va.

Toledo & Ohio Central.—M. Houk, General Passenger Agent, with headquarters at Toledo, Ohio, has resigned.

Wabash.—W. S. Newhall has been appointed Chief Engineer, with headquarters at St. Louis, Mo., succeeding the late Mr. Lincoln.

Washington, Alexandria & Mount Vernon.—C. P. King has been elected President, succeeding G. E. Abbot, resigned.

Willmar & Sioux Falls.—F. Rogers, General Freight and Passenger Agent, has resigned.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

ARROWHEAD & KOOTENAY.—Grading is reported begun on the 35-mile extension from Lardo, B. C., Kootenay Lake, to Girard on Trout Lake.

ATLANTIC & LAKE SUPERIOR.—It is said that this line which runs from a connection with the Intercolonial at Metapedia, Que., to New Carlisle, about 100 miles, will be extended to Port Daniel, a distance of 22 miles.

AURORA, ELGIN & CHICAGO (ELECTRIC).—See Railroad News column.

BALTIMORE & OHIO.—Surveys are reported for a new line in Pennsylvania from Gratztown up Big Sewickley Creek to the Bair farm in Westmoreland County, four miles. It is said that the line will be continued to the company's coal field near Adamsburg.

BILLINGS & NORTHERN.—Location plans of this new line, which is to be built in Montana, in the interest of the Chicago, Burlington & Quincy, have been filed in the United States Land Office. The projected line is 185 miles long, running between Billings and Armington, Mont., and according to the plan, 140 miles of the distance is located in what is known as the Judith land district. There will be one crossing of the Judith River. (April 18, p. 295.)

CANADIAN PACIFIC.—An officer writes that the projected line from Labelle to Nomingue, by way of L'Annonciation, Que., has been located, and that surveys are entirely completed. Tenders for grading, bridges, etc., have been received but no contracts have as yet been awarded. The proposed line is 22 miles long.

Grading on the seven-mile cut-off from Field to Ottertail, B. C., is completed and track laying has been begun.

CANE BELT.—Surveys for the extension from Bay City, Texas, to Matagorda on Matagorda Bay, 23½ miles, are reported completed and work is said to have been begun. It is said that the line will be completed in time to handle the rice crop this season.

CARNEGIE & MCDONALD STREET (ELECTRIC).—Incorporation was granted this company in Pennsylvania June 5, to build an electric road from the western line of the Borough of Carnegie, Allegheny County, to the eastern line of McDonald Borough, in the same county, a distance of 10 miles. J. W. Nesbitt, Oakdale, Pa., is President.

CENTRAL NEW ENGLAND.—Announcement is made that a satisfactory route around the Montague farm has been found and that before the first of August the link will be completed and trains will be running to Springfield. (Jan. 10, p. 31.)

CHATEAUGAY.—Surveys are reported for the proposed change of this narrow gage line to standard gage. It is thought that the survey and estimate will be completed by Aug. 1, and that contracts will be let at that time. The length of the road is 73 miles, and the estimated cost of the work $1,000,000. (April 25, p. 315.)

CHESAPEAKE & OHIO.—Contract to build the extension of the Big Sandy Division from Whitehouse, Ky., to the Breaks of the Big Sandy River in Virginia, about 75 miles, has been let to Langhorn & Langhorn, of Richmond, Va.

CHICAGO, BURLINGTON & QUINCY.—In regard to double-track work in progress, an officer writes that the double-track west of Chicago is completed to Nodaway, 424 miles west of Chicago, and will be completed to Red Oak, 444 miles, before winter. Between Red Oak and the Missouri River there are two separate lines which are practically equivalent to double-track during heavy business, but the company expects to go ahead with the double-tracking west of Red Oak, along the main line, and will have that practically completed within another year. This work has been carried on simultaneously with the reduction of grades, and at the same time curves of 3 and 4 deg. have been eliminated, making straight lines in many places where there were reverse curves, and leaving nothing in excess of 1½ deg. Something like 70 miles of old roadbed has been abandoned entirely in securing a new and better location.

COLUMBUS, EUFAULA & GULF.—Ground has been broken for this projected line which is to run from Columbus, Ga., to St. Andrews Bay, Fla., by way of Eufaula, Ala., a distance of 200 miles. The crews are now seven miles out from Geneva, Ala. The present plan is to run a line from Columbus to Tuskegee, Ala., and thence to Rockford and Birmingham. (Construction Supplement, March 14, 1902.)

DALLAS, CLEBURNE & SOUTHWESTERN.—Charter was filed at Austin, Texas, June 4 for a railroad between Cleburne and Dallas, Texas, 50 miles. The general office is at Cleburne and the incorporators are: I. D. Myers, W. A. McDonald and Paul Nelson, of Cleburne, and others.

DELAWARE ROADS (ELECTRIC).—Surveys are reported for the Wilmington & New Castle, New Castle & Delaware City and the Delaware City & Middletown Connecting trolley lines. The route will be 14 miles between terminals, with a total of 26 miles operated.

DES MOINES, IOWA FALLS & NORTHERN.—Plans for the entrance into Des Moines have been changed, and instead of running trains over the Great Western tracks from Berwick, Iowa, the company will build a line of its own paralleling the Great Western from a point three miles north of Berwick into Des Moines. The company has closed a lease by which it will be able to run its passenger trains into the union depot. It will build freight yards in East Des Moines and handle its own freight service. Rights of way are now being secured. The grading of this road has been completed as far south as Maxwell, Story County, and track laying is to be begun at once on the completed portion from McCaulsburg through Maxwell. The remainder of the work of grading between Maxwell and Des Moines will be pushed as rapidly as possible, and the company hopes to have the line in operation for its entire length by Nov. 1. (March 21, p. 217.)

DES MOINES TERMINAL.—This company completed organization June 6, with a capital stock of $200,000, and headquarters at Des Moines, Iowa. The company has broad privileges with the specific purpose of building terminal tracks, etc., in Des Moines. F. M. Hubbell is President, and H. D. Thompson, Vice-President.

EASTERN OF ALABAMA.—Surveys are reported for the location of the proposed line from Talladega to Pyriton, Clay County, Ill., a distance of 25 miles. The Louisville & Nashville will build this road and operate it for a term of years, after which it is to become the Eastern Railway of Alabama. (April 11, p. 277.)

EASTON & RAUBSVILLE.—This company was incorporated June 14 to build a steam railroad five miles long from Easton, Pa., to Raubsville, in Northampton County, Pa. Louis T. Muthart, of Allentown, Pa., is President.

EAST ST. LOUIS TERMINAL.—This company has been incorporated at East St. Louis, Ill., to build a railroad from Harrisonville, Monroe County, Ill., to Alton, Madison County, going through St. Clair County, a distance of about 65 miles. The incorporators and first board of directors are: M. M. Stevens, W. S. Forman, Robert Bethmann and others, of East St. Louis.

FERROCARRIL DE RIO SECO.—This company has filed articles of incorporation in New Jersey to build a railroad from Pasco de Cardenas, in the State of Tabasco, Mexico, and Chiltepec, on the Gulf of Campeachy, about 60 miles northeast. Benjamin Barrios, of the City of Mexico; Alexander Potter and Julius Ferguson, of New York City, are the incorporators. Wm. Rollinson, 142 Market street, Newark, is the legal representative.

FREDERICKSBURG, CULPEPER & RAPPAHANNOCK.—This is the correct name of the company previously referred to as the Fredericksburg & Rappahannock, which proposes to build a railroad from Fredericksburg, Va., through Culpeper and Sperryville to Washington, Va., a distance of about 55 miles. A company known as the Eastern Virginia Construction Co., of which A. G. Willis, of Culpeper, is President, was formed last fall to build the line, and according to most recent advices, subscriptions are now being taken in the different counties through which the road passes.

GREENBRIER, MONONGAHELA & PITTSBURGH.—This company was incorporated in West Virginia June 5, to build a railroad from Pocahontas to Parsons in Tucker County, and thence along the Cheat River to Port Marion, a total of about 30 miles. The incorporators are John T. McGraw, M. D. Post and others, of Grafton, W. Va.

ILLINOIS & MISSISSIPPI.—This company has been incorporated in Illinois to build from Peoria through the Counties of Peoria, Knox, Warren, Mercer and Rock Island to Rock Island, Ill. The incorporators and first board of directors are: Jerome J. Crowley, Rupert J. Barry, M. P. Breen and others, of Chicago.

INSULAR.—A company with this name filed articles of incorporation in New Jersey June 5, with the intention of building a number of short lines in the eastern part of Cuba. One of these will run from Havana to Mariel, about 35 miles, and another will run from Havana to Guinis, 35 miles; Punta Brook to Guira de Melena, about 16 miles; El Cano to Marsaqua, about 14 miles; San Diego de Las Vegas to Vegricel, four miles, and El Cano to Congregeras, seven miles. The incorporators are: W. J. Wright, Demarest, N. J.; Isaac Gans, 101 East 123d street, New York, and others. They decline to state who is behind the project, but $500,000 of the $2,500,000 stock, all of which is common, has been paid up. The principal office of the company is at 34 Empedrado street, Havana, Cuba.

INTERCOLONIAL.—Arrangements have been made between the Dominion Government and the Canada Atlantic, subject to approval by Parliament, which amounts to a formality, which will give the Intercolonial entrance into the wheat territory of the West. The plan is that in return for permanent traffic arrangements on the Canada Atlantic, the Government will guarantee the interest on the company's bonds to enable them to double-track their line from Coteau to Depot Harbor. It is not expected that the Government will ever be called upon to spend any money on this interest account, but it will place the Intercolonial in position to successfully compete for the export grain trade, and will supply it practically a direct line from the Great Lakes to the Atlantic seaboard. This is the outcome of the inability of the Webb-Meyer syndicate to exercise their option on the Canada Atlantic.

IOWA & DAKOTA CENTRAL.—Articles of incorporation were filed with the Secretary of State of Iowa June 3 for a road from Centerville, Iowa, to Sioux City, a distance of 250 miles. H. F. Reddig is President, and H. W. Seamon is Vice-President.

IOWA HEMATITE (ELECTRIC).—Articles of incorporation were filed with the Secretary of Iowa June 7. The company has a number of privileges with the immediate object of building an interurban electric line between Lansing and Waukeon in Allamakee County, Iowa, to reach iron mines.

JOLIET & WESTERN.—Incorporation has been granted this company to build from Joliet, Ill., through the Counties of Will, Du Page, Cook, DeKalb, McHenry and Lake to a point on the Wisconsin line near Beloit, a distance of about 80 miles. The incorporators and first board of directors are Geo. H. Monroe and Chas. S. Seaver, of Joliet, Ill.; J. R. Steward, of Plano, and others.

LOUISVILLE & NASHVILLE.—The Knoxville, LaFollette & Jellico, incorporated in the interest of the above, has won its case in contest with the Southern for certain rights of way in the Clear Fork Valley, Ky. Louisville & Nashville engineers ran a preliminary line up the Clear Fork River to the State line, a distance of 10 miles. Engineers of the Southern located their line over the right of way and location of the Louisville & Nashville for a portion of this distance. It was held by the Chancellor that the rights of way were determined by priority of location, and the decision of the two suits filed, one by the Cumberland, and one by the Knoxville, LaFollette & Jellico, gives the former right of way as surveyed for three miles, and the latter for seven miles, but either one is at liberty to parallel the tracks of the other.

LYLE-GOLDENDALE.—Preliminary surveys for this line in Washington are reported completed and bids are wanted for grading 27½ miles from the head of Swale Canyon to Lyle, on the Columbia River.

MEXICAN NATIONAL.—Broad gaging on the line of the Texas-Mexican is reported completed between Laredo and Alice, Texas, 118 miles.

MEXICAN ROADS.—The Mexican Government has granted a concession to Alejandre Elzuezabel for a road between Torreon and Parral, Mexico, passing through the towns of Lerdo, Mapimi, El Oro and Inde. It will be about 125 miles long.

MIDDLESBORO MINERAL.—Surveys began May 29 for this projected line through Bell and Harlan Counties, Ky., for which amended articles of incorporation were filed May 19. J. H. Bartlett, Middlesboro, Ky., is President. (May 30, p. 404.)

MINNEAPOLIS, SUPERIOR, ST. PAUL & WINNIPEG.—See Railroad News column.

NEW JERSEY ROADS (ELECTRIC).—A charter has been secured for an electric railroad from Phillipsburg, N. J., to Washington, N. J., by way of Broadway, Stewardsville and New Village, and thence to Hackettstown, by way of Port Colden; north to Oxford Furnace and other points, and south from Washington to Glen Gardner, Highbridge, Clinton and other places, making a total of 45 miles. It is said that work will begin as soon as right of way can be secured.

NORFOLK & WESTERN.—Surveys are reported completed for a line between Kenova, Louisa and Naugatuck, W. Va., a distance of 58 miles, to reach new coal lands recently purchased by the United States Steel Co., in the Flat Top region of West Virginia. Two or three routes have been under consideration and it is thought that the present surveys will be accepted. (Feb. 14, p. 122.)

NORTHERN PACIFIC.—Surveys are reported on the east shore of Flathead Lake, Mont., for a line to run south to a connection with the Northern Pacific at Jocko, Mont.

NORTH SHORE.—Bonds to the amount of $3,500,000 are to be issued by this company, which is the successor to the North Pacific Coast, a narrow gage line extending from San Francisco to Cazadero, Cal., 86 miles, including a ferry six miles long. Of the proceeds of these bonds $500,000 is to be applied to refunding the North Pacific issue which matures in 1912, and bears interest at the rate of 5 per cent. One million three hundred and seventy-five thousand dollars is to be reserved for betterments which include a standard gage line 25½ miles long from Sausalito, Cal., to Mill Valley, Fairfax and San Rafael. This is to be equipped with electricity. A tunnel 3,100 ft. long will also be built to eliminate five miles of the present roadbed and permit of abandoning seven high trestles. (Jan. 17, p. 50.)

ROWLESBURG & PARSONS.—Charter was granted this company June 5 in West Virginia, to build from Powellton, Preston County, to Parsons. The incorporators are M. D. Post and others, of Grafton, and the project seems to be in the same interest as the Greenbrier, Monongahela & Pittsburgh above.

SALAMANCA & LITTLE VALLEY TRACTION.—Incorporation was granted this company on June 3. Application was filed last October for a 14-mile electric road in Chautauqua County, N. Y., to run from Great Valley to Salamanca, and west to Little Valley. J. S. Rockwell and C. W. Hammond, of Buffalo; E. B. Vreeland, of Salamanca, and A. E. Darrow, of Little Valley, are directors.

'SCOOTAC MOUNTAIN.—Contract was let to F. J. Dixon & Co., of Blairsville, Pa., June 2, for a railroad six miles long to start at the junction of the north and south forks of the 'Scootac Creek, Pa., and run down the south fork past the Rock Cabin mines to the mines of the Burns Fire Brick Co. The contractors are allowed 90 days to complete the road, but it is not thought as much time as that will be required. The work will be in charge of Engineer E. E. Ball. The headquarters of the company are Williamsport, Pa.

SCRANTON, DUNMORE & MOOSIC LAKE.—Incorporation was granted this company June 3 to build a steam railroad 10 miles long from Dunmore to Moosic Lake, in Allegheny County, Pa. Timothy Burke, Dunmore, Pa., is President.

TOLEDO & WATERLOO (ELECTRIC).—Surveys are reported for an electric line between the points in Iowa. It is not yet decided whether the route will be by way of Traer or Dysart. The former route is 38 miles long; the latter 41.

TOLEDO & WESTERN (ELECTRIC).—It is said that this road, which is projected from Toledo, Ohio, 46 miles west to Fayette, by way of Lyons, Morenci and Sylvania, with a branch from Sylvania to Adrian, Mich., 20 miles, and which now has about 60 miles of track laid, will be extended at once from Adrian to Jackson, a distance of 32 miles direct. Work is reported now in progress on the extension from Morenci, the present terminus of the main line, to Fayette, seven miles. The Lake Shore & Michigan Southern has a line in operation between Jackson and Adrian, but it goes by a more roundabout route than the one now projected.

UTAH ROADS.—See article in another column.

VIRGINIA ROADS.—Franchise has been granted to J. E. Clayton, of Baltimore, Md., who owns a large tract of mineral property near Pulaski, Va., to build a railroad from his holdings through the town to a connection with the Norfolk & Western, and work will be begun at once.

WASHINGTON & OREGON ELECTRIC RAILWAY, LIGHT & POWER.—This company has obtained franchise for an electric railroad and electric power transmission in Walla Walla, Wash., and Dayton, and expects to build interurban lines. The projected route starts at Dayton and goes down the Touchet River to Huntsville and Waitsburg, and from that point to Walla Walla. From Walla Walla a line will be built to Pendleton by way of Milton, Weston, Athene and Adams. Dayton is on the line of the Oregon Railroad & Navigation Co., which will be paralleled by the entire 70 miles of this projected line. H. Mellman and F. M. Romo, the promoters, have engaged W. C. Cheney as electrical engineer to locate one or more power houses. The water power will probably be developed either on the Walla Walla River or on Mill Creek, though there is an available power site on the Touchet River above Dayton.

WASHINGTON STREET SUBWAY (BOSTON).—An agreement has been reached between Mayor Collins and the associated business men of Boston as to the terms of the bill for the subway under Washington street. It is provided that the city shall build a two-track subway at an estimated cost of about $4,000,000. This will be leased by the Boston Elevated for 25 years on a basis of 4½ per cent. After the subway has been in operation for a year, a new one may be built by the city of Boston, either near the tunnel or in any other direction that public convenience may seem to require. This additional subway the Elevated Company is compelled by the terms of the bill to lease. Failing agreement between the Transit Commissioners and the company as to this additional subway, the matter goes to the Railroad Commission.

GENERAL RAILROAD NEWS.

ATCHISON, TOPEKA & SANTA FE.—The California Eastern, formerly known as the Nevada Southern, which runs from Blake to Manvel, Cal., 30 miles through the desert in San Bernardino County, is reported sold to this company.

AURORA, ELGIN & CHICAGO (ELECTRIC).—An increase in authorized stock from $3,000,000 to $4,500,000, of which $1,500,000 is 6 per cent. cumulative preferred, has been made. The line is projected from Chicago to Wheaton, Aurora and Batavia, Ill., a distance of about 45 miles, and also from Wheaton, 16 miles northwest to Elgin, and it is thought that the main line will be in operation during July and that the Wheaton-Elgin branch will be completed some time during the year. L. F. Wolf is President.

CHICAGO, ROCK ISLAND & PACIFIC.—This company has absorbed by lease the Burlington, Cedar Rapids & Northern, which operates by ownership and control 1,288 miles of road, the main line extending from Burlington, Iowa, and Owatonna, Minn., 289 miles. It is provided that the lease is for 999 years, and that the rental shall be equal to the sum of all the taxes levied upon each property, or the interest of outstanding bonds and 6 per cent. on outstanding capital. The Rock Island & Peoria, extending from Rock Island, Ill., to Peoria, Ill., 91 miles, with branches bringing the total mileage operated to 121, has been taken over on the same terms.

CHICAGO, ROCK ISLAND & TEXAS.—Application to the Texas Railroad Commission for authority to make a new mortgage to secure bonds at the rate of $30,000 per mile, has been made. The bonds will be a first lien on all property except that between Fort Worth and Terral, Tex., and will be a second lien on that division. With a view to provide for the new extensions to be built in Texas, the capital stock is also to be increased from $3,000,000 to $10,000,000.

CINCINNATI, RICHMOND & MUNCIE.—Under this title the two component parts of this company, consisting of the former Cincinnati, Richmond & Muncie R. R., and of the Chicago & Cincinnati, incorporated to afford an entrance into Cincinnati, were consolidated May 29. The Cincinnati, Richmond & Muncie now operates between Cottage Grove and North Judson, Ind., 168 miles, and has work in progress on an extension to Hammond, Ind., near Chicago.

CITIZENS' TRACTION.—This company has been formed in Pennsylvania, as a consolidation of the former Citizens' Traction Co., the Oil City Street Ry., the Petroleum Street Ry., the Frenchcreek Street, and the Franklin Electric Street companies. The capital stock is $300,000 and Daniel J. Geary, of Oil City, Pa., is President.

COLUMBIA RAILWAY & NAVIGATION.—This property was sold at auction on May 24 to Winters & Chapman, contractors, under an action instituted by them, including all the mechanics' liens, for $36,000. The line has been completed for 22 miles along The Dalles, on the north side of the Columbia River. A plan of reorganization has been approved by the Portland, Ore., Board of Trade, which provides for the organization of a new company to issue $300,000 first mortgage 6 per cent. gold sinking fund bonds and complete a line.

DENISON, BONHAM & NEW ORLEANS.—Issue of $480,000 stock on 24 miles of completed line has been approved by the Texas Railroad Commission. A project to extend the line from its present terminus at Bonham to Beaumont has been talked of. (April 25, p. 315.)

FORT WAYNE SOUTHWESTERN TRACTION.—This company has filed a certificate increasing the capital stock from $600,000 to $1,000,000 and permitting an extension from Fort Wayne to Goshen, Ind., about 50 miles. The company now operates a line 27 miles long. A company known as the Fort Wayne & Goshen was incorporated last January by J. T. Rothwell, Richard Rothwell, James Lynch and others, to build between the same points. (Feb. 14, p. 121.)

IOWA & ST. LOUIS.—This company has made a mortgage to the Illinois Trust & Savings Bank of Chicago and Wm. A. Rule, trustees, to secure $2,000,000 of bonds at the rate of $20,000 per mile upon sections of five miles or more of completed road. The company became an Iowa corporation by filing new articles of incorporation in Iowa last May, making Centerville the headquarters of the company, and providing for a capital stock of $900,000. (May 23, p. 386.)

KANSAS CITY, MEXICO & ORIENT.—A traffic agreement has been agreed upon between this company and the Chihuahua & Pacific, which holds for 10 years and gives full traffic rights to the K. C., M. & O. over the lines of the latter. The Chihuahua & Pacific runs from Tabalaopa and Chihuahua to Minaca, Mexico.

MINNEAPOLIS, SUPERIOR, ST. PAUL & WINNIPEG.—This projected line in Minnesota, Wisconsin, etc., filed a trust deed on June 5 to the Standard Trust Co., of New York, to secure $10,000,000 in 5 per cent. 30-year bonds covering the roadbed, superstructures, right of way, franchise, etc., of 320 miles of road between Minneapolis and Baudette, Minn., and 120 miles between Anoka and Superior, Wis. The company filed incorporation articles in Minnesota May 12 and expects to build 100 miles this year. (May 16, p. 372.)

PENNSYLVANIA.—Announcement is made of the acquisition of the Middletown & Cincinnati, which runs from Middletown to Middletown Junction, Ohio, 14 miles, and has connections with the Cincinnati, Hamilton & Dayton, the Cleveland, Cincinnati, Chicago & St. Louis, the Cincinnati, Lebanon & Northern, and the Pittsburgh, Cincinnati, Chicago & St. Louis. It was projected and built by Paul J. Sorg. The consideration is not stated.

PENNSYLVANIA & MAHONING VALLEY.—N. W. Harris & Co. offer $1,750,000 first and refunding mortgage 5 per cent. gold bonds, due May 1, 1922, and free of tax in the State of Pennsylvania. The company has $3,000,000 of preferred stock outstanding and authorized, $5,000,000 of common outstanding and authorized, and reserves $750,000 of bonds to retire underlying bonds, and $250,000 for improvements, in addition to the present issue, making a total of $2,750,000 bonds. It was incorporated May 23, 1902, as a consolidation of a number of electric lines in Pennsylvania and Ohio. The management of the property is under the control of M. A. Verner, Pittsburgh; M. T. Herrick, Cleveland; James Parmelee, Cleveland, and B. F. Miles, Cleveland. (May 30, p. 404.)

UNITED TRACTION (PITTSBURGH).—The lease of the Pittsburgh & Charleroi Street R. R. was ratified June 4. Work on this line is being rushed and it is expected that it will be in operation by the first of next year, extending a distance of 22 miles through the southern end of Allegheny County into Washington County, Pa. An annual rental of $35,000 will be paid.